[redacted]

Chemistry Library
QC
770
.U56
v.4
no.11

NUCLEAR SCIENCE ABSTRACTS

Vol. 4 No. 11

Table of Contents for June 15, 1950

Category	Abstract	Page
DOCUMENTS REFERENCE LIST		iii
BIOLOGY AND MEDICINE		501
Radiation Effects	3274	
Radiation Hazards and Protection	3287	
Radiation Sickness	3301	
Radiotherapy	3302	
Toxicology Studies	3342	
Tracer Applications	3360	
CHEMISTRY		521
Analytical Procedures	3404	
Fluorine and Fluorocarbons	3405	
Laboratories and Equipment	3408	
Rare Earths and Rare Earth Compounds	3410	
Separation Procedures	3411	
Syntheses	3414	
Transuranic Elements and Compounds	3415	
Uranium and Uranium Compounds	3417	
ENGINEERING		525
Heat Transfer and Fluid Flow	3429	
Tracer Applications	3431	
Vacuum Systems	3434	
MINERALOGY, METALLURGY, AND CERAMICS		526
Ceramics and Refractories	3435	
Geology and Geophysics	3437	
Metals and Metallurgy	3441	
Minerals and Mineralogy	3448	
Tracer Applications	3453	
PHYSICS		529
Astrophysics	3459	
Cosmic Radiation and Mesons	3461	
Instruments	3477	
Isotopes Separation	3479	
Mass Spectrography	3481	
Mathematics	3482	
Measuring Instruments and Techniques	3483	
Molecular Structure	3499	
Neutrons	3500	
Nuclear Physics	3506	
Nuclear Properties	3507	
Nuclear Reactors	3515	
Nuclear Transformation	3516	
Particle Accelerators	3526	
Radiation Effects	3529	
Radiation Absorption and Scattering	3530	
Radioactivity	3539	
Theoretical Physics	3554	

TABLE OF CONTENTS FOR JUNE 15, 1950

Category	Abstract	Page
AUTHOR INDEX		A
SUBJECT INDEX		D
NUCLIDE INDEX		N
FOREIGN GEOGRAPHIC INDEX		P
PUBLISHED DOCUMENTS INDEX		P
NNES ANNOUNCEMENT		Q

DOCUMENTS REFERENCE LIST

Vol. 4 No. 11

U. S. ATOMIC ENERGY COMMISSION DECLASSIFIED DOCUMENTS

Document	Title, Author	Abstract
AECD-2814	A Study of the Effect of 2,3-Dimercaptopropanol (BAL) upon the Metabolism of Plutonium. B. Kawin and D. H. Copp.	3342
AECD-2815	Isotope Techniques for Determining the Uranium Content of Biological Materials. A. Rothstein, A. Frenkel, and C. Larrabee.	3417
AECD-2816	Very Fast Particle Resolution by Means of Crystal Radiation Counters and Pulsed Amplifiers. L. F. Wouters.	3483
AECD-2817	Fission Product Yields. K. Way and N. Dismuke.	3516
AECD-2818	The Determination of Thorium in High Grade and Low Grade Ores. F. S. Grimaldi and C. A. Marsh.	3448
AECD-2819	A Method for the Spectrographic Determinations of Impurities of High Concentration in Uranium Oxides. L. E. Burkhart.	3418
AECD-2820	Jet-Helix Extractor. L. Wainwright.	3411
AECD-2821	Chemical Properties of Berkelium. S. C. Thompson and G. T. Seaborg.	3415
AECD-2822	Preparation of Transplutonium Isotopes by Neutron Irradiation. A. Ghiorso, R. A. James, L. O. Morgan, and G. T. Seaborg.	3517
AECD-2823	The Borides of Uranium and Thorium. L. Brewer, D. L. Sawyer, D. H. Templeton, and C. H. Dauben.	3419
AECD-2824	The Rapid Fluorimetric Determination of Uranium in Low Grade Ores; A Preliminary Report. F. S. Grimaldi and H. Levine.	3420
AECD-2825	A Direct Quantitative Fluorimetric Method for the Determination of Small Amounts of Uranium in the Field and Laboratory. F. Grimaldi, F. N. Ward, and R. Kreher.	3421
AECD-2826	The Uranium-Cobalt System. W. K. Noyce and A. H. Daane.	3422
AECD-2827	The Gas Phase Reactions of Fluorine in Water. Part I. Reation Times and Reaction Products in a Dynamic Fluorine-Water System. W. Davis, Jr., F. D. Rosen, R. H. Winget, Jr., and R. H. Wiswall, Jr.	3405
AECD-2828	An Interspecies Comparison of the Radiotoxicities of X-Ray, Sr^{89}, and Pu^{239}. C. L. Prosser and M. N. Swift.	3343
AECD-2829	Spectrophotometric Studies of the Uranyl Citrate Complex. L. Feldman, W. F. Neuman, and J. R. Havill.	3423

DOCUMENTS REFERENCE LIST

Document	Title, Author	Abstract
AECD-2830	The Heat of Formation of Thorium Tetrachloride. L. Eyring and E. F. Westrum, Jr.	3416
AECD-2831	Super Ion Gauge. F. H. Schmidt.	3434
	U. S. ATOMIC ENERGY COMMISSION UNCLASSIFIED DOCUMENTS	
AECU-741	The Chelation of Cerium as a Function of pH Using Thenoyltrifluoracetone. J. F. Suttle.	3410
AECU-832	The Pile as a Service Instrument for Chemical Analysis. C. O. Muehlhause and G. E. Thomas.	3515
ALI-23	Investigation of Stack Gas Filtering Requirements and Development of Suitable Filters; Report No. 8. Arthur D. Little, Inc.	3428
ANL-4418	Machine Tool Hoods. N. G. Bohlin and S. S. Gold.	3408
ANL-4419	Design of a Vacuum Frame Hood. B. M. Abraham and N. Bohlin.	3409
ISC-77	Evidence for the Formation of Ce^{139} by an n-γ Reaction. A. J. Moses and D. S. Martin.	3539
JHU-4	Annual Report; 1949. G. H. Dieke.	3499
K-555	Determination of Purity by Freezing Point Depression. Purity and Freezing Point of Hexadecafluoroheptane. V. E. Anderson and G. D. Oliver.	3406
K-583	Transforming Observed First Differences to Uncorrelated Variates. A. de la Garza and G. A. Garrett.	3482
K-590	The Preparation and Reactions of Substituted Polychloro 1, 1-Difluoroethanes. J. T. Barr, Jr., J. D. Gibson, and R. H. Lafferty, Jr.	3407
MIT-1043	The Thermal Expansion Characteristics of Beryllium. R. M. Treco.	3441
MITG-206	Concentration and Sizing Tests with the Dutch State Cone. E. S. Frohling.	3449
NYOO-98	Final Technical Report. L. G. Bassett, S. E. Wiberley, and J. U. Shepardson.	3450
NYO-558	Heat Transfer by Natural Convection from Horizontal Cylinders to Liquid Metals; Second Quarterly Progress Report for October 1, 1949, to December 31, 1949. S. C. Hyman and C. F. Bonilla.	3429
NYOO-1505	Fire Protection Precautions for Handling Uranium Turnings, Chips, Borings, Sawdust, and Powder. E. J. Kehoe, F. L. Brannigan, and M. Eisenbud.	3424
NYO-1511	Monthly Report of Laboratory Activities, February 1950. New York Operations Office.	3287
ORNL-333	Measurements of the Half-Life and Mean Energy of Tritium Decay. G. H. Jenks, F. H. Sweeton, and J. A. Ghormley.	3540
ORNL-414	Changes in the Plasma of the Rat During Fasting: The Influence of Genetic Factors upon the Sugar and Cholesterol Levels. H. I. Kohn.	3269
ORNL-416	On Straight-Ahead γ Transmission with a Minimum in the Cross Section. G. Young.	3531

DOCUMENTS REFERENCE LIST

Document	Title, Author	Abstract
ORNL-635	Controlling Variables in Liquid-Liquid Extraction from Single Drops. W. S. Farmer.	3412
ORNL-650	Palladium Film Fast Neutron Detector. B. R. Gossick.	3484
ORNL-658	Heterogeneity in Pyrimidine Nucleotides. W. E. Cohn.	3413
UCLA-57	A Study of Hemorrhagic Rib Markings Produced in Rats by Air Blast. A. Frisoli and B. Cassen.	3270
UCLA-63	The Investigation of Hepatic Function by Clearance Techniques. I. Bromosulfalein Clearance in Rabbits. A. E. Lewis.	3271
UCLA-65	Chronic Essential Fatty Acid Deficiency. I. Its Effect on Fertility and Wound Healing. A. B. Decker and J. F. Mead.	3272
UCRL-487	Bibliography of Meson Research. D. F. Sherman.	3461
UCRL-549	The Distribution of the Positive Negative Ratio for Mesons. B. Rankin.	3462
UCRL-552	The Aluminum-Aluminum Oxide System at High Temperatures. L. Brewer and A. W. Searcy.	3454
UCRL-558	Production of π^- Mesons in Proton-Proton Collisions. V. Peterson.	3463
UCRL-565	Transition Curves of 330-Mev Bremsstrahlung. W. Blocker, R. Kenney, and W. K. H. Panofsky.	3518
UCRL-567	Inelastic Scattering of 30-Mev Protons from Carbon and Aluminum. A. Silverman.	3530
UCRL-580	γ Rays from Capture of Negative π Mesons in Hydrogen. W. K. H. Panofsky.	3464
UCRL-599	Electron-Optical Properties of Homogeneous Magnetic and Radial Electric Fields. A. A. Garren and L. Smith.	3526
UCRL-605	Skeletal Changes in Severe Phosphorus Deficiency in the Rat. I. Tibia, Metacarpal, Costochondral Junction, Caudal Vertebra. R. D. Coleman, H. Becks, F. V. N. Kohl, and D. H. Copp.	3273
UCRL-611	Deuterons Brombarded by 90-Mev Neutrons. W. Hartsough, M. Hill and W. M. Powell.	3500
UCRL-612	The Inelastic Scattering of High Energy Neutrons by Deuterons and the Neutron-Neutron Interaction. G. F. Chew.	3501
UCRL-614	High Energy Photons from Proton-Nucleon Collisions. B. J. Moyer, W. E. Crandall, R. Hildebrand, and H. York.	3541
UCRL-615	A Technique for Measuring Meson Production Cross Sections in the Forward Direction. H. A. Wilcox, W. F. Cartwright, C. Richman, and M. N. Whitehead.	3465
UCRL-620	Nuclear Reactions Induced by High Energy X-rays. K. Strauch.	3519
UCRL-621	Energy Dependence of Proton-Proton Scattering over the Interval of 19 to 32 Mev. B. Cork.	3532
UCRL-624	New Radioactive Isotopes of Iridium. T. C. Chu.	3542
UCRL-625	Radioactive Isotopes of Tantalum and Wolfram II. G. Wilkinson.	3543
UCRL-627	Physics Division Quarterly Report; November and December 1949 and January 1950. University of California Radiation Laboratory.	3455

DOCUMENTS REFERENCE LIST

Document	Title, Author	Abstract
UCRL-628	Summary of the Research Progress Meeting of February 23, 1950. H. P. Kramer.	3456
UCRL-630	Production of π Mesons in Nucleon-Nucleon Collisions. K. A. Brueckner.	3466
UCRL-639	Carrier Free Radioisotopes from Cyclotron Targets. VIII. Preparation and Isolation of $Cu^{66,67}$ from Zinc. H. R. Haymond, R. D. Maxwell, W. M. Garrison, and J. G. Hamilton.	3520
UCRL-642	On the Use of the Tomonaga Intermediate Coupling Method in Meson Theory. K. M. Watson, and E. W. Hart.	3554
UCRL-643	On Radioactive Drugs. B. M. Tolbert.	3360
UCRL-644	Preparation of Tritiated Cholesterol. D. Kritchevsky, M. W. Biggs, and N. K. Freeman.	3414
UCRL-645	The Path of Oxygen in Photosynthesis. G. D. Dorough and M. Calvin.	3361

BIOLOGY AND MEDICINE

3269 Changes in the Plasma of the Rat During Fasting: The Influence of Genetic Factors upon the Sugar and Cholesterol Levels. Henry I. Kohn. ORNL-414, Apr. 11, 1950. 20p.

The composition of the plasma of the rat was examined during the course of 1 week of fasting. Data for the Osborne-Mendel, Holtzman, and Sprague-Dawley strains agreed well enough to be pooled. During the first 4 to 5 days of fasting, the changes in chloride and albumin-globulin ratio were negligible, after which both rose moderately. During the entire week, the levels of sugar, nonprotein nitrogen, and total protein oscillated systematically about the 24-hr fasting level. Hemoglobin fell about 1 g % during the first day, and thereafter it rose at the rate of about 0.5 g % per day. Similar results were obtained with the Tumblebrook Farm hooded strain, except in the case of the sugar level, which was somewhat lower than in the other strains, and which fell steadily during fasting. Breeding experiments established that this difference depended chiefly on genetic characters which present several interesting problems. The plasma cholesterol levels were not affected by fasting. In the Sprague-Dawley and Osborne-Mendel strains they were twice those in the Holtzman and Tumblebrook hooded strains. Breeding experiments showed that the genetic basis for this difference involved a number of genes. Following hypophysectomy, the cholesterol rose to a new level, which was the same in both the "high" and "low" genetic types. 19 references. (auth)

3270 A Study of Hemorrhagic Rib Markings Produced in Rats by Air Blast. Arturo Frisoli and Benedict Cassen. UCLA-57, Mar. 20, 1950. 9p.

Hemorrhagic rib markings have often been observed during autopsy on the deflated lungs of victims of high-explosive blast. Interpretations have been made, on one hand, by considering that the ribs produce shadows, and, on the other hand by considering that the ribs produce intensified damage when they are forced against the lungs. To determine definitely between these alternatives, a technique has been developed of fixing the lungs of rats in their inflated state after blast injury. These fixed lung preparations clearly demonstrate that the hemorrhagic bands are under the ribs and are most marked under the false ribs. Further, a freely movable disk of metal held loosely to the chest wall will produce intensified damage under it rather than cast a shadow. (auth)

3271 The Investigation of Hepatic Function by Clearance Techniques. I. Bromsulfalein Clearance in Rabbits. Alvin E. Lewis. UCLA-63, Mar. 10, 1950. 30p.

On the basis of derived equations relating rate of administration of bromsulfalein (BSP) to rate of excretion and plasma levels, practical methods for studying hepatic clearance have been devised. By these methods it has been demonstrated that BSP is confined to the plasma compartment and that the clearance of BSP below the saturation level is independent of plasma concentration. Feeding produces an increase in clearance of 63.1%, but there is no change in the maximum excretory capacity. On this basis it has been concluded that feeding causes an increase in hepatic blood flow which is a passive response to increased splanchnic flow. Furthermore, the glycogen content of the cell has no effect on the clearance of BSP. 10 references. (auth)

BIOLOGY AND MEDICINE

3272 Chronic Essential Fatty Acid Deficiency. I. Its Effect on Fertility and Wound Healing. Arthur B. Decker and James F. Mead. UCLA-65, Mar. 23, 1950. 12p.

The present study describes the effect of two different types of stress upon chronic essential fatty acid (EFA) deficient mice. First, the ability to recover from a slight wound is compared in the chronic EFA-deficient animal and the control with a corn-oil supplement. Second, the effect of this diet on the ability of the animal to produce young is investigated. Chronic EFA-deficient mice were found to exhibit symptoms of the acute disease after a minor injury. Females in this state cannot produce young.

3273 Skeletal Changes in Severe Phosphorus Deficiency in the Rat. I. Tibia, Metacarpal, Costochondral Junction, Caudal Vertebra. R. D. Coleman, H. Becks, F. van Nouhuys Kohl, and D. H. Copp. UCRL-605, Feb. 20, 1950. 33p.

Severe rickets was produced in growing rats fed diets very low in phosphorus (0.005 to 0.015%) despite the presence of presumably adequate amounts of vitamins A (25 U.S.P. units per gram) and D (8 I.U./g). Roentgenograms indicated a marked lack of mineral in the skeleton of the deficient animals and a delay in skeletal maturation in the vertebra. Histological studies were made of tibia, metacarpal, caudal vertebra, and costochondral junction. Signs of severe rickets were evident in all 4 bones. The following changes were observed in the epiphyseal region: (1) an increase in width of the epiphyseal cartilage, (2) lack of a provisional zone of calcification, (3) failure of epiphyseal cartilage to be resorbed, (4) compression of chondrocytes, (5) formation of osteoid tissue, (6) lack of remodeling resorption of osteoid matrix, and (7) invasion of the cartilage by blood vessels and replacement with osteoid matrix occurring at approximately 60 to 70 days of age. While an increase in the Ca/P ratio from 28/1 to 78/1 did not appear to intensify the severity of rickets in these animals, definite changes were observed with increasing age and time on the low-phosphorus diet. The gross deformities of the bones in rickets may be attributed to the failure of the intercolumnar matrix and osteoid matrix to calcify. Remodeling resorption also fails to take place, and the volume of osteoid is increased. 19 references. (auth)

3274 Biological Evaluation of 20 Million Volt Roentgen Rays. Henry Quastler and Elisabeth F. Lenzl. Am. J. Roentgenol. Radium Therapy 63, 566-74 (1950) Apr.

The efficiency of 20 million volt roentgen rays produced by the betatron was compared with that of conventional roentgen rays at different dose levels. The lethal effect of divided doses on C57 black mice was used as test reaction. At a dosage level which causes death after about 1 week of daily treatments, high-energy rays are about as efficient as in the massive dose test; at a dosage level which causes death after about 3 weeks of daily treatments, their efficiency is significantly lowered. The lower relative efficiency of high-energy roentgen rays at small doses is compared to the higher relative efficiency of neutrons under similar conditions. 10 references. (auth)

BIOLOGY AND MEDICINE

3275 The Biological Significance of the Tissue Dose of Ionizing Radiations. Harald H. Rossi. Trans. New York Acad. Sci. 2, 270-5(1949) June.

A general discussion of ionizing radiations is given, with special reference to the problem of a quantitative measurement of radiation and the question as to how far the result of such measurements serves to define the conditions under which a radiobiological experiment is performed. Spatial and temporal considerations of dosimetry in connection with ionization and induced electromagnetic fields are qualitatively discussed; the author suggests the further collaboration of physicists with biologists for more exact dosimetry measurements and for discussion of the complex theoretical problems which arise in treatment of biological material.

3276 Depression of Tracer Ion Uptake Curve in Rat Erythrocytes Following Total Body X-Irradiation. Thomas G. Hennessy and Rex L. Huff. Proc. Soc. Exptl. Biol. Med. 73, 436-9(1950) Mar.

Groups consisting of 5 adult female Curtis Dunning rats weighing approximately 200 g were given total-body x-irradiation, delivered by a 180-kv machine through a 0.5-mm Cu and 3-mm Al filtration; the animals were individually irradiated in lucite containers. Four series were irradiated: series A and B consisted of 4 groups which received 5, 25, 125, and 250 r of the whole-body irradiation; series C consisted of 3 groups that received 5, 10, and 25 r; there was also a control series. Each animal received intravenously by tail vein a labeling dose of Fe^{59} in 0.5 cc of $FeCl_3$ solution containing 2 γ total iron and approximately 0.07 μc of Fe^{59}. In series A the labeling dose was given 2 days after the x-irradiation, in series B 1 day after, and in series C within 4 hr after the irradiation. Following the administration of the labeling dose of Fe^{59}, 0.5-cc samples of blood were drawn by means of cardiac puncture, heparinized and centrifuged. The hematocrit was recorded, and the samples were tested for radioactivity. Graphs of the red cell Fe^{59} uptake curve in in the rats at the various dosage levels of total-body x-irradiation are given. The results obtained in these studies show that the radioactive iron red cell uptake curve is a sensitive indicator of x-irradiation damage to the bone marrow; the histological evidence of the sensitivity of erythroid tissue to x-irradiation also was confirmed.

3277 The Developmental Genetics of the Rg Mutant in Maize. Leo W. Mericle. Am. J. Botany 37, 100-16 (1950) Feb.

In order to determine in what respects the developmental pattern of ragged maize (containing the ragged leaf mutant, Rg, which is situated as a dominant gene on the third chromosome) differs from the normal pattern, macroscopic and microscopic anatomical studies and physiological transport and accumulation investigations (utilizing P^{32}) were performed. Normal and Rg plants showed little difference in their ability to absorb P^{32}, and in both the young and mature leaves the distribution of radioactivity throughout the normal leaf areas were the same for both types; however, the ragged areas of the Rg plants showed a marked departure from corresponding areas on the normal plants, the ragged areas containing a lower concentration of P^{32} than almost any other portion of the leaf. Areas immediately above the ragged areas were very low in P^{32} also, but the areas immediately below showed relatively high concentrations, which suggest

BIOLOGY AND MEDICINE

an accumulation of P^{32} here because of an inability to transport further (across the ragged areas). It is assumed that the Rg mutation has only a localized effect on the vascular system and/or adjacent ground tissue. Accumulation pattern differences suggest potentially ragged areas prior to the visible manifestation. The results of the anatomical studies are also presented. 26 references.

3278 The Effect of X-Ray Irradiation on the Teeth and Supporting Structures of the Mouse. M. S. Burstone. J. Dental Research 29, 220-31(1950) Apr.

Forty-four Swiss and C57 black mice, 2 to 28 days of age, were irradiated in the area of the mandibular joint and the molar teeth; littermates and littermate controls were used whenever possible. The x-rays were delivered by a Philips Metalix contact x-ray machine operating at 50 kv with no filtration, at a target distance of 20 mm and at the output rate of 5,000 r/min; the three dosages which were used were 1,500, 3,000, and 5,000 r. Following the irradiation, 32 of the mice which survived were sacrificed at intervals from 5 to 37 days; control animals were also sacrificed, and the weights and sex were recorded; the heads of the mice were examined by serial sectioning for changes in the dental structures. It was found that the degree of radiation damage to the teeth and jaws of mice is dependent upon the age at which the animals are irradiated and the stage of histogenesis of the individual teeth. With dosages of 5,000 r the cells in the ameloblastic layer appear as low cuboidal or squamous-type cells; there is a cessation of histodifferentiation of new ameloblasts. Dosages of 1,500 to 3,000 r produce less marked changes. Dosages of 1,500 to 5,000 r severely damage the odontoblastic layer; the surviving odontoblasts resemble osteoblasts, and an irregular, amorphous, acidophilic staining substance (osteodentin) is formed; there is a retardation or cessation of root formation (first and second molars), while the development of the coronal dentin is only slightly altered. Odontoblasts are more radiosensitive than ameloblasts; the development of the basal and alveolar portions of the jaw is retarded or stopped completely; there is an acute inflammatory response within the enamel organ and in the adjacent soft tissues. The late postirradiation changes include atrophy and fibrosis of the pulp and ankylosis of the root to the alveolar bone. (auth)

3279 The Effect of X-Rays Upon Mutation of the Gene A in Maize. L. J. Stadler and Herschel Roman. Genetics 33, 273-303(1948) May

In order to study the nature of the mutations at the A locus induced by x-rays, selected F_1 progenies produced by an aa x AA cross after irradiation of the male parent just before pollination with a 1,000 r dose were extensively studied for mutations, gametophyte viability, homozygote and compound viability, crossing-over effects, pachytene cytological changes, and effects noted from unstable duplications. From 415 A losses, 2 normals which were free of segregating pollen defects and one which showed segregation of subnormal, but not aborted pollen, were selected for thorough studies on lethality, transmission, and crossing-over. The results are extensively reported and discussed. 18 references.

3280 The Effects of Local X-Ray Irradiation on the Tail Development of Young Axolotls. V. V. Brunst. J. Morphology 86, 115-41(1950) Jan.

Young axolotls were irradiated while under anesthesia with 1,000, 2,000, 3,000, or 6,000 r delivered by a 43-kv machine with no filtration at a target distance of 17 cm to localized areas in the tail region, the rest of the body being carefully shielded; of the 120 animals tested, all recovered in water immediately after irradiation. The treated animals were photographed, described, fixed in a solution of bichloride of mercury, imbedded in paraffin, and sectioned 35 to 40 days and 85 to 100 days following irradiation. Two types of effects were noted: the primary type was characterized by inflammation, degeneration of the epithelium, notochord, and the neural tube, and inhibition of growth, in evidence 35 days after irradiation; the secondary type which followed the primary and was characterized by inhibition of growth of the irradiated portions (the tissue appearing normal but lacking the ability to divide) and the subsequent growth in many cases of a second tail (which never attained normal size and had varying anatomical characteristics). 64 references.

3281 Histological and Histochemical Studies of the Skin of Guinea Pigs Treated with X-Rays. J. Fredericq. Compt. rend. soc. biol. 142, 850-3(1948) June (in French).

Eleven guinea pigs received radiation doses of 3,000 r, filtered through 1 mm Al, and 10 others received 1,500 r and 1,000 r doses. Epidermal morphology was followed in all animals for 30 days for appearance of lesions, various cytological abnormalities, and restitution. The presence of sulfhydril groups in the regenerating areas indicates, the author concludes, that these play a role in the restitution of cells which have been damaged by radiation.

3282 The Influence of the Spleen on Hematopoietic Recovery After Irradiation Injury. L. O. Jacobson, E. L. Simmons, W. F. Bethard, E. K. Marks, and M. J. Robson. Proc. Soc. Exptl. Biol. Med. 73, 455-9(1950) Mar.

Young adult female mice were exposed to 1,025 r whole-body x-irradiation delivered by a 250-kv source through an 0.25-mm Cu filter. The spleens of these mice were mobilized surgically through an abdominal incision and lead-protected during irradiation in one group and mobilized but not lead-protected during irradiation in another group. The bone marrow and lymphatic tissues were destroyed, and no regeneration was apparent on the tenth day in the animals irradiated without lead protection of the spleen. In the animals with lead protection of the spleen during irradiation, these tissues were not depleted of free hematopoietic cells, and the bone marrow and the lymph nodes were normal in cellularity 8 days after irradiation. Several possible interpretations of the role of the spleen under the conditions of these experiments are discussed. (auth)

3283 Influence of X-Rays on Limb Regeneration in Urodele Amphibians. V. V. Brunst. Quart. Rev. Biol. 25, 1-29(1950) Mar.

A review is presented on the mode of action of x-rays in inhibiting limb regeneration in urodele amphibians, on the source of cells for the regenerating blastema, and on the influence of x-rays on growth and differentiation in the regenerative process; the author discusses in detail the results of a number of important works on the subject, including some seldom-referred-to Russian papers. The primary reaction of the organism to the irradiation may consist in profound alterations in the cells, often seen as pathological degeneration and death; inflammation may also be the primary reaction. The surviving tissues recover their normal appearance, but not their potentialities; regeneration is lost. Postamputation irradiation causes not only an arrest of regeneration, but also a rapid decrease in the size of the treated regenerate, due to an inflammatory process; irradiation prior to amputation causes no size reduction. Suppression of cell division does not affect the differentiation process; tissue and organ differentiation in irradiated animals may be completed despite a cessation of growth. Other results are discussed. 220 ref.

BIOLOGY AND MEDICINE

3284 On the Exponential Law of the Radiation Effect. W. Minder. Radiologia Clin. 18, 300-4(1949)(in German).

As is known, the exponential shape of the dose curve is explained by the "target" (or "hit") theory of the radiation effect on living cells by considering this effect as due to quantized events whose probability is expressed by certain volumes, the "target volumes" of the effect under consideration. In the light of recent investigations of chemical reactions produced under the action of x-rays (oxidation of H_2O, reduction of $KMnO_4$, formation of HCl from CCl_4), the author shows that the exponential law of these processes can easily be explained with the aid of such mechanisms as reversible reactions, secondary reactions, or inhibitory effects of compounds present; the work of these mechanisms is governed by certain probabilities, each expressed by a volume, the "reverse action volume"; the latter's absolute dimensions vary within the same limits (100 to 400 A linear dimension) that characterize the "target volume" of the radiobiological theory (e.g., the inactivation of various bacteriophagic microorganisms by x-ray action). These analogies cannot be accidental and should motivate a reshaping of the target theory. That the concepts involved have a deeper physicochemical meaning than that accepted by the biological theory is corroborated by the fact that for many chemical reactions, induced by x-rays, there exist diluting upper limits below which a radiochemical reaction does not depend on the concentration; at those limits the distances between molecules involved reach the same values, 100 to 400 A, mentioned above. A concept which describes this phenomenon, and which evidently underlies all the others surveyed above, is that of energy transportation without loss, performed along a characteristic elementary distance.

3285 On the Mutation of the Tobacco Mosaic Virus. I. Opatowski. J. Gen. Physiol. 33, 171-6(1949) Nov.

Experiments on x-ray–induced mutations of tobacco mosaic virus with radiation doses of 0 to 49,000 r and mutation rates of 0.079 to 5.275% are analyzed on the basis of ionization theory. Three alternate assumptions are used in calculating the size of the volume in which the primary mutation process develops: this volume is a protein, from which it is found that the volume is identical with the hexagonal cell unit described by x-ray diffraction studies on virus protein; this volume is nucleic acid, from which it is found that one-fourth of the total nucleic acid content is involved in the mutation process; this volume is phosphorus, from which it is found that half of the total P content is in-

volved in the mutation process. The relation between induced and spontaneous mutation is examined, and the author concludes that natural ionizing radiations are insignificant for the spontaneous mutation of the virus.

3286 Proceedings of the Second Conference on the Biology of Normal and Atypical Pigment Cell Growth, Held at New York, Nov. 18-19, 1949. Zoologica 35, 1-32 (1950) Apr. 17.

Among the papers presented was the following: X-ray Effects of Mouse Pigmentation as Related to Melanoblast Distribution, by Herman B. Chase and Virginia W. Smith. In experiments in producing hair-color changes with x-ray doses of 200 to 1,000 r, it was found that the percentage of follicles producing only white hair after irradiation increases with the dose and dose rate. The authors conclude that the reservoir of melanoblasts is within the epidermal follicle and that x-irradiation destroys the source of supply of the granules, namely, the epidermal melanoblasts of the follicle,

3287 Monthly Report of Laboratory Activities; February 1950. New York Operations Office. NYO-1511, nd. 12p.

A summary of the New York Operations Office Health and Safety Division laboratory activities for the month of February is presented. This covers the work of the Instruments Branch and Analytical Laboratory and the laboratory activities of the Radiation Branch. (auth)

3288 "A" Bomb Burns. Patrick Clarkson. Guy's Hosp. Gaz. 64, 86-94(1950) Mar. 11.

The first part of a discussion on atomic-bomb burns is presented, in which the physics of nuclear fissions, the pattern of disaster (types of effects), and acute diffuse ionizing radiation illness are described in separate sections. In the nuclear-fission section the atom and nucleus, ionization and the roentgen unit of dosage, types of ionizing radiation (α, β, neutron particle, and γ radiation), and nuclear fission and fusion are briefly discussed, and the chain of events occurring when an atomic bomb explodes is outlined. In the disaster section the main patterns of above-ground explosions, surface explosions, and underwater explosions are presented, and the main properties of radiation, thermal, and blast effects are included. In the acute ionizing radiation section it is mentioned that doses of 400 to 600 r of whole-body radiation are usually 50% fatal, while those exceeding 600 r are usually totally fatal; the main phenomena (hemorrhagic symptoms) appear after a variable latent period and are followed by bacterial invasion. Some late effects are leukemia, bone sarcoma, and, possibly, mutations. Possible types of therapy are discussed and consist in prophylaxis by preliminary bleeding, administration of phenylhydrazine and desoxycorticosterone, and increasing resistance by preliminary x-rays.

3289 "A" Bomb Burns. Patrick Clarkson. Guy's Hosp. Gaz. 64, 120-4(1950) Mar. 25.

This is the second part of a general article covering the effects of atomic bombs, particularly burns. This section explains the dosages and types of radiation necessary to produce local radiation burns and the typical manifestations of radiation burns. Delayed but persistent vesiculation (onset in 2 to 3 days and lasting 4 to 5 weeks) is seen in these burns, in contrast to thermal burns which show almost immediate signs (2 to 3 hr) which disappear rapidly (2 to 3 days): persistent pain and delayed healing also serve to distinguish ionizing radiation burns. Radiation burns evolve into a dense dermal or/and subcutaneous fibrosis and a thin atrophic unstable epithelium, which may break down and form an ulcer and, later, become malignant. Radiation burns receive treatment similar to thermal burns, and most have to be repaired after partial healing by skin flaps, etc. In concluding, the author stresses the need for adequate and simplified methods of treating the burn patients.

3290 The Atomic Bomb Versus Survival. Melville J. Aston. Military Surgeon 106, 270-5(1950) Apr.

In this general article the elementary mechanics of the atomic bomb are first briefly discussed, and then the radiation, blast, and burns effects attendant to atomic bombings are described. The author notes that too much emphasis has been placed on the radiation effects, which accounted only for 15% of the casualties at Hiroshima and Nagasaki. The author considers the problem of adequate mass treatment of burns to be far more important than therapy of radiation. The author suggests that atomic medicine be brought to the fore more prominently and studied more widely and adequately as one of the means of preparation for an atomic attack. He ends on the note that proper preparation for mass evacuation of bombed cities and mass treatment of victims is essential today.

3291 Atomic Warfare and Animals. J. H. Wilkins. Bio-Chem. Rev. 21, 3-5, 21(1950) Mar.

The four main effects of an atomic bomb explosion—flash, blast, fission products, and radiations—are discussed in this general article on atomic radiation. Symptoms of radiation sickness in dogs are outlined, and such methods of treatment as warmth, intravenous injections of plasma and/or saline, demulcents, sulfa drugs, penicillin, protamine, toluidine blue, and rutin are described. Methods to be used following the explosion, including decontamination procedures, are presented.

3292 Blood Changes in Luminizers Using Radioactive Material. Ethel Browning. Brit. Med. J. 1, 428-31(1949) Mar. 12.

In a 7-year study of 2,737 workers who used radioactive material (and 100 control workers), complete blood analyses were done while they were working, and, of these, 366 were followed up. Exposure was limited to small amounts by various precautionary methods and occurred from external irradiation by α particles, β and γ rays, radon inhalation, ingestion from hand contamination, and inhalation of radioactive dust. Transient lymphocytosis, the presence of Türk cells, premyelocytes, and premature large mononuclear cells were found, as well as a rare occurrence of anemia. The author discusses the findings and concludes that the blood changes are due to a slight temporary hyperstimulation of the reticuloendothelial system.

3293 Destructive Aspects of Atomic Explosion. Elbert DeCoursey. S. Dakota J. Med. Pharm. 3, 71-3(1950) Mar. (See also NSA 1-241).

A general discussion is presented on the symptoms and pathology of ionizing radiations, such as those seen after the atomic explosions at Nagasaki and Hiroshima. The severity of the radiation effects varied inversely as the

distance from the radiation source. Leukopenia, nausea, vomiting, diarrhea, fever, hemorrhages, thrombocytopenia, and other symptoms are classified as to time of appearance and relation to the severity of the patient's condition. The ionizing radiation affected mainly the lymphoid and hematopoietic tissues, skin, genital organs, and gastrointestinal tract, as seen in about 260 autopsies in Japan. Even as few as 3 days after irradiation there was atrophy of the lymphoid elements in the lymph nodes, spleen, and gastrointestinal tract. In the bone marrow of dying victims there was an absence of the hematopoietic cells except for foci of young erythroid elements, but at the end of the first week some evidence of regeneration was present. Baldness was the surest sign of ionization, occurring in the fourth or fifth week; the testes showed prominent changes, having almost all their sex cells destroyed; the ovaries showed minimal changes. Spectacular hemorrhages appeared in the kidneys and intestines, and those of the pharynx and intestine often resulted in death. In conclusion, the author notes that the effects on tissue of α and β particles, γ rays, x-rays, and fast or slow neutrons are similar qualitatively.

3294 Effects of Extreme Heat on Man. I. Protection of Man Against Conflagration Heat. Konrad Buettner. U.S. Air Force School of Aviation Medicine, Project No. 21-02-103, Report No. 1, 1-18(1950) Feb.

The results of a project investigating heat-protection means for man are presented, and a heat-resistant suit made of 0.009-mm thick aluminum pasted on cotton fabric is described. The author concludes that in addition to ordinary conflagrations, such an aluminum suit (or suits of other bright metals) would be effective against atomic-heat radiation; bright textiles would also be appropriate.

3295 Late Radiation Effects in Roentgen Therapy for Hyperthyroidism; Their Possible Bearing on the Use of Radioactive Iodine. Edith H. Quimby and Sidney C. Werner. J. Am. Med. Assoc. 140, 1046-7(1949) July 23 (Correspondence).

Long-term follow-ups on patients receiving I^{131} for hyperthyroid conditions are necessary before it can be definitely stated whether or not this form of therapy may result in late degenerative malignancy in treated areas. Three definite cases out of 10 cases of further malignancy were found in records of 101 radiologists and thyroid experts; these had all received heavy radiation doses. Since the dose of x-ray is 3,000 to 3,500 r delivered to the whole gland, and the dose of I^{131} is 5,000 to 6,000 equivalent r delivered to the whole gland, but concentrated in such a way in specific parts that it is thought that the dose in some parts may be as high as 30,000 r, the possibility of subsequent malignancy is probably far greater with I^{131} than with x-ray therapy.

3296 Lead-Containing Clay for Shielding Roentgen Ray Treatment of the Skin. Robert Kaldeck. Arch. Dermatol. and Syphilol. 59, 665-6(1949) June (Clinical note).

A clay for more accurate shielding of areas difficult to protect by standard rubberized lead or lead foil was compounded from fine lead powder (77%), petrolatum (9%), plastic clay (5%), and talcum powder (9%). This compound was found to be satisfactory for clinical use as regards malleability, elasticity, resiliency, and ease of application. Comparison tests were performed of the shielding ability of the clay and a rubberized lead shield 1.5 mm in thickness for radiation delivered at 84 kv, at a focal distance of 11.5 cm, giving 2,000 and 3,000 r. The author concludes that the clay gives the same protection as a comparable thickness of rubberized lead, but that a 4.5-mm thickness is easier to use and gives an increased safety factor; savings of time and material and greater accuracy and safety in the shielding of small lesions, especially those under intensive treatment and on curved locations, are the primary advantages of the clay.

BIOLOGY AND MEDICINE

3297 Maximum Allowable Concentrations of Atmospheric Impurities. Philip Drinker and Warren A. Cook. J. Ind. Hyg. Toxicol. 31, 51-4(1949) Jan.

In a discussion of maximum allowable concentrations of air contaminants, the author considered the use of a zone of response method for classifying vapor concentrations. Toxic substances are broken up into six arbitrary groups in terms of the effective range; radon gas and other radioactive gases are placed in the sixth and most toxic group, having maximum allowable concentrations of below 0.1 ppm.

3298 Radiation Exposure of Personnel Handling the Monel Metal Nasopharyngeal Radium Applicator. Henry J. Rubin, Barney M. Kully, and Raymond D. Finkle. Ann. Otol., Rhinol. & Laryngol. 59, 90-101(1950) Mar.

In a carefully monitored series of treatments with the 50-mg Monel metal nasopharyngeal radium applicator, total-body irradiation did not exceed 6 mr/treatment for the physician and assistant; the tolerance dose for the whole body is 300 mr/week. The average exposure of the entire length of both index fingers of the physician was 26 mr, and of several finger tips 50 mr/treatment; 600 mr/week has been tentatively adopted as the permissible exposure for hands and fingers. The maximum number of treatments which one physician may administer weekly by the technique described is 12. The results suggest that generally accepted recommendations as to the number of treatments physicians may administer without endangering themselves are too high for safety; lead shields or other accessories for the radium applicator or modifications in its construction might reduce the dose delivered to the physician's finger tips and thereby permit a larger number of treatments. The authors conclude that if the technique of any physician differs appreciably from the one described, it should be monitored to ascertain the number of treatments he may administer by his method without exceeding tolerance. 18 references. (auth)

3299 Remarks on Several Cases of Cutaneous Hyper-Radiosensitivity. J. Reboul and J. M Meynard. J. Radiol. Electrol. 30, 732-3(1949)(in French).

Four cases of reaction to radiotherapy are given in detail: one received 6 doses of 250 r/dose delivered at 200 kv through a filter of 1 mm Cu and 1 mm Al at a distance of 50 cm and a rate of 12 r/min, resulting in a radiodermatitis; the second received 5 doses of 250 r/dose at 200 kv through the same filter and distance at a rate of 14 r/min, resulting in radiodermatitis; the third received the 3 doses with radiation delivered as in the second case except that the focal distance was 40 cm, resulting in peeling, and, after

a second course of irradiation of 15 doses at 200 r/dose delivered at 220 kv through a filter of 1 mm Cu, resulting in dermatitis; the last received 3 doses of 250 r/dose delivered at 180 kv through 1 mm Cu and 1 mm Al at a distance of 40 cm, resulting in an exudative radiodermatitis 4 days after the last dose. In these cases all technical imperfections of the therapeutic course were eliminated, and similar courses on other individuals did not cause any reaction. The authors conclude that certain individuals are hypersensitive to these doses and discuss the possibility that percentage plots of the population reacting against the dose may show a sigmoid population distribution for sensitivity.

3300 The Use of Antihistamine Ointment in Conjunction with Deep X-Ray Therapy. Louis J. Gelber. N. Y. Physician 34, 22, 24, 46, 48(1950) Apr.

A series of experiments was carried out to determine to what degree antihistamine substance in ointment form reduces skin reactions to irradiation and whether or not there is an increase in skin tolerance to irradiation. A total of 31 cases was studied, some with a 1% solution of Euphorbia pilulifera, some with Rayderm Ointment, and some with both agents; irradiation was carried out at 1,300 to 2,200 r in air, the radiation being delivered by a 200-kv machine at a 50-cm target distance through a filtration of 0.5 mm Cu and 1 mm Al. The results of 5 of the cases are presented in tabular form. It was found that all methods achieved good results, the combined method yielding the most satisfactory results; with it, 2,200 r in air could be delivered with less reaction than 1,300 r without medication.

3301 Considerations of Radiation Sickness and Its Therapy. A. Hervé. Brux. méd. 29, 445-50(1949)(in French).

Observations of 210 cases receiving radiation delivered at 151 to 200 kv and 59 to 400 kv show that 34.4% and 16.9% developed radiation symptoms at low and high tensions, respectively. The author concludes that higher voltages are better tolerated for the same dose than the lower voltages, but that other physical factors and specific radiation sensitivity must also be taken into consideration. Vitamin B complex therapy gave good or favorable results in 46 out of 62 cases, showing an initial remission of gastro-intestinal symptoms.

3302 Beta Irradiation. An Evaluation of a Radium-D Applicator for Ophthalmic Use. Fred M. Wilson. Am. J. Ophthalmology 33, 539-48(1950) Apr.

Thirty-two rabbits, weighing 4 to 6 lb, were given general anesthesia, and their eyes were irradiated with various doses of radium and radon; one eye received the radon and the other the radium emanation for purposes of comparison. The radium-D applicator contained 10 mc of radium, supposedly capable of delivering about 200 β r/min; the radium-D was covered at the contact point of application with 0.05 mm of of Al. The radon emanation was administered in a kidney-shaped applicator containing about three 7 to 8-mm radon needles. The treatment dosages for both applicators were expressed in g-sec. It was found that the critical dose for a consistent, minimal corneal lesion with radium-D was approximately 25 g-sec, or 41 min (with the 10-mc applicator). Lesions produced by the radon were more severe following lower doses, a minimal lesion appearing after the application of 10 g-sec of radon. Other factors are discussed. The author concludes that the radium-D applicator has three important fundamental qualitites to consider: low photon activity, with consequent almost pure β-ray emission; low-energy β emission, a disadvantage in that it means softer, less penetrating β irradiation; and low output, a disadvantage in that it necessitates treatment over an extended period of time. The disadvantages pointed out restrict the use of this device in ophthalmology.

3303 Beta Irradiation in Ophthalmology. George M. Haik. New Orleans Med. Surg. J. 102, 504-12(1950) Apr.

The results of the treatment of vernal conjunctivitis, new growths, infections, and glaucoma by β irradiation are presented; the author used an Lliff applicator containing 50 mg of radium filtered through 1 mm of monel metal and applied over a surface 10 mm long and 5 mm wide. The author has treated 15 cases of vernal conjunctivitis with 1 to 6 applications of 2 to 3 min each at weekly intervals; only 2 of the patients treated in 1947 and 1948 have required further therapy. A total of 7 papillomas have been treated successfully, usually with a total of 15 min of application over a 3-week period; 25 cases of pterygia have been treated with irradiation for a total of 10 to 15 min given in 2 or 3 treatments. Other instances of successful application of β irradiation are included. It is concluded that β irradiation has now become established as a satisfactory method of treatment for certain diseases and conditions affecting the internal eye and including those discussed here; it is also useful as a preoperative and postoperative measure in keratoplasty and keratectomy.

3304 Beta Irradiation as a Possible Therapeutic Agent in Glaucoma. George M. Haik, Louis A. Breffeilh, and Aeleta Barber. Am. J. Ophthalmology 31, 945-52 (1948) Aug.

Experiments were performed to determine the effect of β irradiation on the ciliary body and to determine the degree of destruction which could be brought about in that body without lens injury. One case is given in detail; 18 adult rabbits received radium applications of 50 mg over the ciliary body, for 30-min periods at 7 day intervals, in 4 groups, which received 1, 2, 3, and 4, treatments, respectively. One animal from each group was preserved for further study; the others were observed and sacrificed at 5 to 42 days after the first treatment. Gross and microscopic histological analyses were done, reported, and discussed. The authors conclude: that while vascular changes were achieved in most cases, damage to the lens also resulted in most instances where the desired vascular changes occurred; and that the construction of an applicator which would eliminate the γ rays, but permit β irradiation, would make irradiation an excellent therapeutic method. The results of the one human case treated were inconclusive, but no deleterious effects were noted.

3305 Cancer and the Artificial Radioactive Elements. A. Hervé. Paris medical 40, 158-63(1950) Mar. 18 (in French).

The author discusses the limitations of cancer-therapy methods involving the use of artificially radioactive elements. The paper is based on the personal experience of

the author at the Centre Anti-Cancéreux of the University of Liége. Two elements have been used at this institution, P^{32} and I^{131}. Treatment techniques and results are described for several diseases, including leukemia, lymphosarcoma, and Hodgkin's disease. It is concluded that the radioisotopes, while they provide a very helpful tool for cancer therapy, cannot be expected to give sensational cures.

3306 Cancer of the Center Face. J. B. Howell. Southern Med. J. 43, 283-90(1950) Apr.

The results of the treatment of 19 cases of epithelioma of the nose and 14 cases of epithelioma of the lids and canthi by radium therapy are presented. Interstitial radium needles were inserted 1 cm apart and were allowed to remain in place for about 168 hr so as to deliver a dose of 6,000 to 12,000 r to the area; needles of 0.5 to 4.0 cm in length, containing 0.66 to 2.4 mg of radium with a filtration of 0.5 to 0.6 mm of platinum iridium are used. One failure is reported for the nasal epitheliomas, but none for the lid and canthi epitheliomas; both groups have been followed from 1 to 3 years. The incidence of radiation damage was small in these cases; methods of avoiding cataract formation are discussed.

3307 Carcinoma of the Cervix Concomitant with Pregnancy. Marvin G. Sadugor, James P. Palmer, and Melvin C. Reinhard. Am. J. Obstet. Gynecol. 57, 933-8(1949) May.

A review of 4,652 cases of cervical carcinoma was done in order to correlate concomitant pregnancy with this condition; it was decided that 124 of these cases had the two conditions coexisting, and these are reviewed with respect to age, gravidity and stage of pregnancy, symptoms, type of lesion, end results of therapy, and treatment used. The therapy is exclusively radiological, consisting in x-irradiation of 400 to 500 r through 1 port or 100 to 150 r through each of 4 ports daily for a total of 4,000 r within a 45-day period; this is followed immediately by intracavitary radium applications given in one dose of 50 to 100 hr; the total irradiation, from x-ray and radium, delivered to a point 2 cm lateral to the cervical canal is calculated to be 8,500 to 9,000 r. The findings indicate no significant differences in the incidence or course of the carcinoma for pregnant and nonpregnant cases; the authors conclude that better results are shown when conservative treatment is used than when radical surgery is performed prior to irradiation.

3308 Carcinoma of the Nasopharynx: Report of 150 Cases. M. W. Simmons and I. M. Ariel. Surg. Gynecol. Obstet. 88, 763-75(1949) June.

The results of the treatment of 150 cases of carcinoma of the nasopharynx are presented; the sole treatment was irradiation with fractional doses of x-rays at 200 to 250 kv, supplemented with nasopharyngeal applications of radium; cervical and distant metastases were also treated with x-rays. In the 128 fatal cases, the average duration of life from the onset of the symptoms was 27 months. The net 5-year survival rate was 9.8%, all of which cases had developed unilateral cervical metastases before treatment. No cures were obtained in cases complicated with intracranial extensions.

3309 Carcinoma of the Thyroid Gland. Warren H. Cole, Danely P. Slaughter, and James D. Majarakis. Surg. Gynecol. Obstet. 89, 349-56(1940) Sept.

This is an extensive review of other literature including 54 cases of thyroid carcinoma occurring in 663 patients having thyroidectomy for nodular goiter. The material is treated in terms of sex, age, type of carcinoma, type of goiter, diagnosis, pathology, and therapy. The authors conclude that x-irradiation and radon seed implantation are valuable in the therapy of certain types of carcinoma, but that except for occasional cases, I^{131} therapy can contribute little to the cure of the condition.

3310 Coexistent Bronchogenic Carcinoma and Active Pulmonary Tuberculosis. Edward Robbins and Gertrude Silverman. Cancer 2, 65-97(1949) Jan.

After an historical review of the subject, 11 cases of bronchogenic carcinoma and 1 case of bronchial adenoma are presented in detail. Four of these cases received irradiation of fractionated doses totaling 400 to 4,500 r. An extensive discussion of the diagnosis, therapy, and autopsy findings is presented; the authors conclude that in the 4 cases which received irradiation, tuberculosis was apparently activated in 3, which is considered strong contraindication for the use of irradiation where tuberculosis has not been definitely eliminated as a concurrent disease.

3311 Concerning the Absorption of Energy in Radiotherapy. A. Hervé. J. belge radiol. 31, 310-27 (1948)(in French).

The author considers that the dose volume, including the tumor and its periphery, is the important consideration in calculating the energy absorbed. A method of dose-volume determination is given; the calculation shows dose dependency on focal distance and field area. The optimum effective dose, the author concludes, should depend not only on the tumor and the skin tolerance, but also on the total organ tolerance for radiation.

3312 Deep Radiotherapy Associated with Nitrogen Mustard in the Treatment of Malignant Lymphogranulomas. Carlos Gil y Gil. J. Radiol. Electrol. 31, 111-12(1950)(in French).

The combination of the action of radiation on the lymphatic system and nitrogen mustard on the hemopoietic system was found to cause remission in 9 out of 14 cases treated. Radiation doses of 1,200 r were not limited to the usual abdominal and bone ports, but were extended to include smaller lymphatic-tissue sites such as the inguinal, iliac, retroperitoneal, mesenteric, and periaortic regions. The author concludes that that extreme caution must be taken, especially because of the danger of leukopenia.

3313 Depth Dose Measurements in the Esophagus in Roentgen Rotation Therapy. Kurt Lidén. Acta Radiol. 30, 64-8(1948).

An apparatus for measuring depth dose in the esophagus is described which, when calibrated at 165 kv with a filter of 0.5 mm of Cu and 1.0 mm of Al, will give a measurement in the 200 r (central normal depth dose) range which is accurate on most patients with clinical variabilities. Using the same chambers and not altering the constants of calibration, the error was found to be less than 6%.

BIOLOGY AND MEDICINE

3314 Diagnosis and Management of Fundal Carcinoma. L. C. Scheffey. Southern Med. J. 42, 44-52(1949).

The symptomatology and diagnosis of carcinoma of the fundus uteri are discussed. The author's results, in terms of 5-year survivals, in different categories of treatment are presented: of 15 patients treated solely but adequately by surgery alone, there were 9 survivors (60%); adequate or inadequate surgery, together with radium or x-ray at some phase of the treatment, was applied to 34 patients, with 16 survivors (47%); of 29 patients treated only by radium there were 15 survivors (51.7%); 2 patients treated only with x-ray did not survive; 35 patients received combined radium and x-ray therapy, 16 of whom survived (45.7%); 23 patients were treated only with preoperative radium and subsequent adequate surgery, with 21 survivors (91.2%).

3315 Dosimetry and Radium Therapy. J. Reboul and J. Duhamel. J. Radiol. Electrol. 31, 112-14(1950)(in French).

By means of a previously proposed operational expression [$I = 50.5 \exp(-1.672x)\exp(-2.534y^2)$ in r/hr] for the dose intensity delivered by needles containing 1 mg of radium, isodose curves are plotted on x and y coordinates for 10 different needle-position configurations. The authors suggest that plots of this type may be of use in restricting doses of radium to the safety limits of 12,000 to 15,000 r.

3316 The Effect of Low-Voltage Roentgen Rays on the Normal and Vascularized Cornea of the Rabbit. A Preliminary Report on the Philips Machine. Harold G. Scheie, Richard H. Dennis, Richard C. Ripple, Larry L. Calkins, and John A. Buesseler. Am. J. Ophthalmology 33, 549-71(1950) Apr.

In order to determine the beneficial and injurious effects of low-voltage x-rays when applied to the eye under controlled conditions and to determine whether or not x-rays might be a satisfactory substitute for β irradiation, the studies described were performed. A Philips contact ray machine was operated at 44 kv and delivered varying total doses either to the normal rabbit eye or the rabbit cornea. It was found that exposure of the rabbit eye of up to 2,000 r weekly for as long as 5 weeks could be performed without apparent damage to the cornea or lens during the following 3.5 months. Exposures as small as 500 r and limited to the cornea, when given weekly for 21 weeks, resulted in transient corneal opacity. Dosages of 5,000 r, given in the same manner, caused permanent corneal opacity and irradiation cataract, first observed 14 months following the first exposure. Vascularization induced by an intracorneal sodium hydroxide injection could be markedly inhibited by the low-voltage x-rays; daily exposure was more effective in inhibiting corneal vascularization than exposures given at longer intervals, and small dosages of 300 r were as effective as larger ones up to 1,000 r. Exposures of 400 r and 500 r repeated 3 and 4 times at approximately 4-week intervals were used clinically in several hundred patients without evidence of cataract formation; these patients have been observed for as long as 2.5 years following treatment.

3317 Effects of Roentgen Irradiation on Germ Plasm in Relation to Infertility. Ira I. Kaplan. Fertility and Sterility 1, 123-45(1950) Mar. (See also NSA 1-1384.)

BIOLOGY AND MEDICINE

The results of the treatment of patients for testicular tumors and similar conditions involving the testes with x-irradiation and the radiotherapeutic treatment of amenorrhea and sterility in women are presented. It was noted from the cases presented that occasionally male patients who received heavy irradiation to the testes recovered normal sperm contents and became fathers of normal children. Treatment in all the amenorrhea and female sterility cases was with high-voltage x-rays delivered by a 200-kv machine with a 0.5-mm Cu and a 1-mm Al filter, at a target distance of 30 to 50 cm; treatment at weekly intervals was directed through the anterior and posterior right and left pelvic fields and to the pituitary area in doses of 50 to 75 r; three series were usually given. The results were very satisfactory, symptoms clearing up in most cases and normal pregnancies occurring; there was no evidence of harmful effects due to the irradiation. The author concludes that this method, when properly given, is a safe and valuable therapeutic procedure for the treatment of amenorrhea and sterility. 45 references.

3318 An Evaluation of Adjunctive Radiotherapy in the Surgical Treatment of Endometrial Carcinoma. Harold Speert and Thos. C. Peightal. Am. J. Obstet. Gynecol. 56, 503-8(1948) Sept.

After a brief review of literature from 1936 to 1947, a survey of 157 patients who had been treated by panhysterectomy and had more than 5-year histories is given; tables include the type of treatment (hysterectomy and/or radium and/or x-ray), 5-year cure rates, cure rates correlated with clinical stage and lesion grade, the type of treatment correlated with the stage, lesion grade, and 5-year cure rate, and a final table of 5-year cure rates as determined by the type of treatment and the lesion grade. The average preoperative radium dose was 2,191.5 mg-hr in 36 cases and 3,000 mg-hr in 10 cases; postoperative x-irradiation was delivered through 4 pelvic ports by a 200-kv machine, using 0.75-mm Cu and 2-mm Al filters and giving 16 to 20 doses of about 300 r per dose. The authors conclude that in these cases preoperative radium intrauterine irradiation was of no value, but postoperative x-ray therapy appeared to be of some value in advanced cases and for tumors of high histological grading.

3319 The Intensity Distribution of the 2 Gr Teleradium Unit of the King Gustaf V's Jubilee Clinic in Lund. Kurt Lidén. Acta Radiol. 30, 76-80(1948).

After a description of the teleradium unit in use, a complete discussion of the technique of measurement of the intensity distribution is given. Isodose curves are given for measurements taken with only a conical filter, without an extra filter, and with a 3-mm Pb filter used without a cone at surface intensities of 66, 91, and 71 Imc, respectively. (Imc is the intensity at 1 cm from a point source of 1 mg of Ra filtered by 0.5 mm of Pt and corresponds to about 8 r/hr.) The radium distribution and radium-skin distance used in this machine have given satisfactory therapeutic results, giving a surface dose of 1,000 r in 113 min with the cone and in 82 min without the cone.

3320 Intra-Uterine Irradiation; the Protection against Emanations when Filling Radium Containers. J. Meine. Fortschr. Gebiete Röntgenstrahlen vereinigt mit Röntgenpraxis 71, 619-23(1949)(in German).

BIOLOGY AND MEDICINE

In order to acquire a better distribution of the doses in irradiation of the uterine cavities, the employment of a "radium chain" as a container instead of the customary tubes is suggested. This chain consists of an arbitrary number of links, each containing a small radium tube weighing 10 mg; further technical directions are given. Various instruments (a plate-holder, pliers, tweezers) are described, which afford a better protection, particularly of the hands, when filling and emptying the radium containers.

3321 Low Dosage Irradiation in Male Infertility; A Negative Report. Charles W. Charny. Fertility and Sterility 1, 150-7(1950) Mar.

Twenty carefully selected and infertile men were irradiated with x-rays in order to ascertain the therapeutic effects; 12 of the patients received x-ray treatment to both the pituitary and testes and 8 to the pituitary alone. The dosage to the pituitary consisted in 3 exposures of 55 r each at weekly intervals; the testes received 3 exposures of 28 r each at weekly intervals. Some radiation effects were noted. In the one patient who consented to a testicular biopsy following the irradiation, severe degeneration of the seminiferous epithelium was noted; even the deep-lying seminiferous tubules were irreparably damaged, as evidenced by the complete disappearance of spermatozoa from the semen. The total number of epithelial cells in the postirradiation semen specimens from the other patients in each case declined, indicating damage. It is concluded that the irradiation dosage was too high; the unfavorable results preclude further investigation. Pituitary irradiation alone, with dosages similar to those employed in the female, appeared to have no beneficial effect on spermatogenesis, as judged by the semen examination.

3322 Measurements of the Functional Activity of a Lingual Goiter with Radioactive Iodine (I^{131}): Surigical Control. M. Dargent, M. Berger, M. Moindrot, R. Moret, and L. Fontes. Lyon Chirurgical 45, 287-96 (1950) Apr. (in French).

Radioactive iodine (I^{131}) was used as an aid in the preoperative localization of thyroid tissue in a girl 13 years old with a lingual tumor, presumably of thyroid nature. The surgical exploration confirmed the results of the iodine test, namely (1) the lingual tumor was really of thyroid nature and (2) small nodules of thyroid tissue were present around the tumor's normal cervical location.

3323 Mixed Tumors of the Thymus. Criteria for Their Differentiation and Their Radiotherapeutic Response. Stuart J. Eisenberg and Philip F. Sahyoun. Arch. Path. 49, 404-17(1950) Apr.

The results of the treatment of several cases of mixed tumors of the thymus with radiotherapy are presented. A total of 7 cases are presented in detail. Fractionated doses of x-rays were delivered to several areas in these cases, some of which were the neck, shoulder, mediastinum, face, thorax, and trunk. Total dosages were 3,600 to 28,925 r delivered over a long period of time. Nitrogen mustard therapy also was administered. It was found that these tumors were arrested by the x-ray therapy, and improvement of the general condition was noted, but complete regression could not be obtained. The characteristics of the tumors are compared with those of Hodgkin's disease.

BIOLOGY AND MEDICINE

3324 Observations Made during Roentgentherapy Relating to Various Types of Cancerous Development and Methods of Protection. H. Coutard. Paris, G. Doin et Cie., 1949. 24p. (in French).

After a development and explanation of mitotic and antimitotic substances which appear periodically in normal cells and which may modify them to the extent of making them neoplastic, the author considers the problem of the use of very small β-ray doses to react with these substances. Radiosensitivity is considered to be a function of the periodicity of the substances; a revision of dosage ideas on this basis, with a method of determining physiological dose on the basis of the actual action of the rays as distinguished from dose-volume measurements, is suggested.

3325 Radiation Therapy of Acute Pancreatitis; a Report of Twenty-eight Cases. Leo M. Levi and Robert B. Engle. Radiology 54, 576-8(1950) Apr.

The results of the treatment of 28 patients with acute pancreatitis by radiotherapy are presented; 2 of these patients were given more than one course of therapy. Twenty-two of the series delivered consisted in radiations at 140 kv through 0.25-mm Cu filtration (plus 1.0-mm Al inherent filtration) at a 20-cm target distance; 7 cases were treated at 200 kv (4 with 0.25-mm Cu filtration added and 4 with 0.5-mm Cu) at a target distance of 52.1 cm; 1 patient was treated at 100 kv through 3.0 mm of Al at a target distance of 20 cm. The series usually consisted in two treatments; the calculated r dose in air per treatment was 75 r; 12 patients received 100 r in air per treatment. The total series never exceeded 300 r and usually was 150 to 225 r. Two of the 28 patients expired. The authors conclude from the results that some patients may obtain relief by this method from vomiting and nausea, distention, or pain.

3326 Radiation Therapy of Oto-Rhino-Laryngeal Infections (Techniques and Statistical Conclusions). Gaston Daniel. J. Radiol. Electrol. 30, 678-80(1949) (in French).

Radiation therapy of the otorhinolaryngeal infections, both acute and chronic, is discussed in terms of the acuteness, previous history, portal of treatment, and extent of radiation. Statistics on 330 cases with various abnormalities and infections are given, combining in some cases radiation and sulfa drugs. In children 70 kv maximum filtered by 2 mm of Al at a focal distance of 15 cm over a diameter of 3 cm for a dose of 30 r/min is used, with slight variation in acute infection; for chronic infections 60 kv maximum under 2 mm of Al at 10 cm over an area of 3 cm in diameter gives a dose of 15, 30, 60, 100, and 150 r/course given twice a week. In acute infections in adults, x-rays were given by a 70 kv maximum 3-ma machine with a filtration of 2 mm of Al at 15 cm. For chronic adult cases, 110 kv was delivered by a 10-ma machine through 5 mm of Al at 12 cm over a 5-cm diameter in successive doses of 100, 200, and 500 r. The semicontact treatment concluded best for acute cases is 70 kv maximum filtered by 2 mm of Al in graduated courses of dosage; for chronic cases, 110 kv maximum with 5 mm of Al is used.

3327 The Radium-Treatment of Cancer of the Tonsil. E. Maier. Radiologia Austriaca 1, 77-83(1948)(in German).

BIOLOGY AND MEDICINE

In 47 cases of cancer of the tonsil a series of radium needles was inserted around the tumor, forming an arch from the soft palate to the base of the tongue; additional teleradiation was given through the regional lymph-node field. In cases with extensive tumors, it was necessary to remove them partially by coagulation before radium treatment. Prolonged radiation is considered advantageous; 27% of a group with extensive involvement and 45% of a group with smaller tumors were cured.

3328 Radium Treatment of Carcinoma of the Cervix during Pregnancy. J. I. Ries. Zentr. Gynäkol. 70, 847-55(1948)(in German).

Radium treatment of a squamous-cell carcinoma of the cervix in a 32-year-old woman in her sixth pregnancy was instituted; a total of 840 mg-hr was administered on five occasions with intervals of a few days. About 3.5 months later a child was born spontaneously at term; the hair growth of the scalp showed no defects. Radium and x-ray treatment was continued until re-examination showed no recurrence. The author concludes that radiotherapy during pregnancy is only permissible after the sixth month, since the danger for the child is too great before this time, even with very moderate dosage. Graphs are presented showing the radiation doses which are injurious to the foetus at different stages of pregnancy.

3329 Recent Advances in Contact Therapy Equipment and Usage. Richard H. Chamberlain. Penn. Med. J. 53, 359-62(1950) Apr.

When it is desirable to irradiate superficial and accessible lesions, low-energy x-rays may be used to furnish uniform and precise dosages without excessive irradiation of normal underlying tissues. The scope of usefulness and flexibility of choice of such "contact" therapy has been greatly widened by the application of x-ray tubes with beryllium windows. These windows pass much greater amounts of low-energy x-rays than have been obtainable before, but require precise physical calibration. Very low energy x-rays are of particular use in accessible cancer, certain lesions of the cornea, hemangiomas, and research adaptions to microscopic radiography. (auth)

3330 Results of Minimal Doses in X-Ray Treatment of Erythema and Leukemia. G. Dantoine. J. Radiol. Electrol. 30, 701-2(1949) (in French).

Difficulties and contraindications of x-ray therapy in blood and allergic symptomology are briefly discussed. In 17 cases of erythema, teletherapy was given at 3.5 m focal distance, 200 kv through a ½-mm Cu and 2-mm Al filter, alternating posterior and anterior ports, 10 to 15 r twice a week, giving a total of 90 r in a series. In 27 cases of myeloid leukemia a splenic course was given at 1 m focal distance, 200 kv through a filter of ½-mm Cu and 2-mm Al filter, a dose of 10 r/course, totaling 70 r/series or a local irradiation of 15 r per course totaling 60 r/series in two groups and and 40 r/series in four groups of courses. In 16 cases of lymphoid leukemia, 10 r/course giving 45 r/series was given, and in 7 cases of monocyte leukemia, 10 r/course with teletherapy totaling 75 r/series and semiteletherapy totaling 40 r/series were given. Results are briefly discussed, but are considered not significant enough for present evaluation.

BIOLOGY AND MEDICINE

3331 Results of Treatment of Carcinoma of the Lip. Grant E. Ward and James W. Hendrick. Surgery 27, 321-42(1950) Mar.

The results of the treatment of 259 cases of carcinoma of the lip by surgery, radiation therapy, or a combined procedure are presented. When the lesion was found to be under 1.5 cm in diameter, 4 to 5 mm deep, and was present in an elderly patient or one who refused operative treatment, x-rays were used. The radiations were directed to the lesions and to the surrounding region (about 0.5 to 1 cm) when it was shown to be tender and indurated. A total of 6,000 to 7,000 r of unfiltered radiation was delivered in doses at 5 to 6 sittings, spaced at 2- to 3-day intervals. In 72 patients who were treated surgically, there was a 5-year cure rate of 89%; in 69 patients treated by x-rays, the rate was 79%; a third group treated by both methods showed a 5-year cure rate of 51%, but the patients in this group had more extensive lesions.

3332 Roentgentherapy in Corneal Grafting. R. Gaudu-cheau, G. P. Sourdille, J. Tardiveau, and R. Lainé. J. Radiol. Electrol. 30, 716-17(1949)(in French).

This is a discussion of the technique used on 29 cases. Total doses of 250 r were administered at 130 kv in 100- to 150-kv doses through a filter of 6 to 7 mm of Al at a distance of 24 cm in a circular area 5 cm in diameter and at an intensity of 3 ma. The results are inconclusive to date, but seem to be satisfactory. Improvement began 36 hr after the first dose of 50 r.

3333 The Royal Prince Alfred Hospital Cancer of the Uterus Follow-up. H. H. Schlink, C. L. Chapman, and F. N. Chenhall. Med. J. Australia 2, 206-7 (1949) Aug. 6.

The results of the treatment of a large number of cases of cancer of the uterus at the Royal Prince Alfred Hospital, Sydney, Australia, are presented; surgery, radium, or a combined therapy was used. The radium therapy consisted in placing 30 mg of radium in the uterus and 20 mg in each fornix of the vagina for 100 hr and a total dose of 7,000 mg-hr; Wertheim hysterectomy was usually performed 4 to 5 weeks later. The 5-year survival rate for the cases treated with the combined method was 52.6%, as compared with 15.6% following radium alone. Other results are included.

3334 The Status of Radiation Therapy in Carcinoma of the Cervix. Eleanor Percival and Archibald D. Campbell. Can. Med. Assoc. J. 62, 335-8(1950) Apr.

The results of the treatment of 261 cases of carcinoma of the cervix with x-ray and radium therapy are presented. In all the cases, except those in stage IV, x-ray and radium therapy were both given; stage IV cases were treated exclusively with x-rays as a palliative measure to lessen bleeding and discharge. In most cases radium was inserted in the uterus and in the cervical canal against the tumor and in each lateral fornix. The radium, screened in 2 mm of brass and 3 mm of rubber, was administered in two treatments 10 days apart for a total dose of 4,500 to 6,000 mg-hr; other radium factors varied with the individual cases. X-ray therapy was administered through 4 ports of 150 cm^2 by a 200-kv machine with a filtration of 0.5 cm of Cu for a total dose of 1,750 to 2,250 r measured in air. There was a 43.2% survival with these cases treated from 1934 to 1943,

an increase of 27.2% over a previous group. Failures occurred in cases with glandular involvement and radioinsensitivity. It is concluded that the continued use of the method described would seem to offer the best prospects for the patient with cervical carcinoma.

3335 The Time of Recurrence of Endometrial Carcinoma. Harold Speert. Am. J. Obstet. Gynecol. 57, 547-52 (1949) Mar.

A summary of 41 cases of recurrence of endometrial carcinoma, including sample case histories of 5 patients, is reported. The recurrences are tabulated with respect to the time elapsing before recurrence, the histological grade of the carcinoma as correlated with the time interval, the recurrence interval according to the clinical stage, and the recurrence interval according to the type of therapy (including panhysterectomy, radium applications, and x-irradiation). The average dose of radium was 3,344 mg-hr; x-irradiation was delivered by a 200-kv machine in a course of 16 to 20 doses of 300 r each through 4 pelvic ports. The author concludes that: preoperative radium irradiation in surgically treated cases neither improved the 5-year cure rate nor prolonged the recurrence interval; tumors in early clinical stages recurred later than more advanced tumors; tumors of low histological grade recurred later than the less differentiated ones.

3336 Treatment by Radiotherapy of Carcinoma of the Auricle. N. Carvalho. Rev. Cir. 15, 57-61(1949) (in Portuguese).

A report on 36 histologically proved cases is presented, 16 of which were treated with radium and 20 with low-voltage x-ray therapy (contact therapy); because of the rapid fall of dosage, contact therapy was preferred. Radium was applied in contact and from the distance of 1.5 cm, with a 1.0-mm Pt and 1.0-mm Cu filter. The dosage oscillated from 240 mg-hr to 1,040 mg-hr (average 400 to 800 mg/hr) as imposed by the extension of the process. Contact therapy was given without filter, 2 cm distance, 5,000 to 8,000 r, also depending on the size of the invaded area. Results: 10 cases are well 2 to 8 years later; 13 are well, but still under observation 1 to 2 years later; 4 recurrences.

3337 Treatment of Benign Conditions of the Uterus with Russian Preparations of Radio-Mesothorium. E. P. Ivanitskaya. Akusherstvo i Ginekol., No. 4, 46-9(1949) July-Aug. (in Russian).

Russian preparations of radiomesothorium were used in the treatment of 75 cases of benign uterine disease, consisting of 52 cases of fibromyoma and 23 cases of metropathia hemorrhagica. Most of the patients suffered from profuse menstruation, and many complained of menorrhagia with symptoms of secondary anemia for several years. Hypertension was observed in very few cases. The radiomesothorium, contained in a platinum filter, was introduced into the uterine cavity; the patient received 1,000 mg-hr, equivalent to 5,000 r at a distance of 1 cm. If the distance of the ovaries from the center of the uterus was considered to be about 5 to 6 cm, then each ovary was exposed to an average of 190 to 300 r. The complications observed were an increased temperature of up to 38.5°C and, in three cases, nausea and vomiting. Of the 75 patients, 71 responded favorably with amenorrhea; the menopause was induced immediately in 42 patients, while in 22 cases it occurred after the first and in 6 others after the second menstrual period.

BIOLOGY AND MEDICINE

3338 Ultra-Conservative Roentgentherapy of Gynecological Conditions (Functional Doses in Pelvic Irradiations). Gaston Daniel. J. Radiol. Electrol. 30, 690-1(1949) (in French).

A brief discussion of the superiority of current therapeutic measures is given. Reactions to radiation therapy such as inflammation, menstrual changes, sterility, infections, and carcinogenesis are described. Where irradiation is the indicated therapy, a total dose of 50 to 100 r delivered at 120 kv through a filter of 5 mm of Al ventrally for single ovary irradiation, and dorsolumbar irradiation delivered at 150 kv through 1 mm of Cu and 1 mm of Al at 40 cm focal distance no lower than dorsal 12 to lumbar 3 are the recommended doses. Semicontact vaginal irradiation and inguinal irradiation for various disorders are considered by the author to be inadvisable in all cases, especially in those of otherwise fertile females.

3339 Urinary Tract Changes in Cervical Carcinoma. William K. Diehl and J. Mason Hundley, Jr. Surg. Gynecol. Obstet. 87, 705-15(1948) Dec.

In order to determine whether parametrial spread of cervical carcinoma or the radiation given as therapy were responsible for the urinary-tract changes noted in clinical studies, 37 cases of all degrees of cervical carcinoma were studied. A complete urological examination was done, and states and changes were correlated with the carcinomas, before and after radiation therapy; all patients were followed for 5 years after the clinic admission. The carcinomas were irradiated with 30 mg of Ra filtered by a 2-mm equivalent of lead filter placed in tandem in a flexible rubber sac in the cervical canal and with 70 mg of Ra filtered by a 3-mm equivalent lead filter placed on an adhesive tape-aluminum foil which was molded over the tumor; the bladder and rectum were protected by heavy filters; the packing was left in place for 30 hr, giving a dose of 3,000 mg-hr which was repeated after 3 weeks. After 3 weeks, deep x-ray doses of 6,000 to 8,000 r were given through 4 ports in daily doses and repeated after a 12-week interval. The method and observations are discussed in detail: the authors conclude that urinary involvement increases in frequency as the original cervical carcinoma becomes more advanced, that hydronephrosis and hydroureter during or after therapy is associated with advancing malignancy, and that radiation will not cause uretral stricture if the dosage is not excessive and if the source of radiation is displaced from the ureter by accurate maximal vaginal packing.

3340 X-Ray Therapy of Primary Inoperable Carcinoma of the Breast. Ruth J. Guttmann. Radiology 54, 567-71(1950) Apr.

The results of the treatment of 82 cases of primary inoperable carcinoma of the breast with radiotherapy are presented. The radiations were delivered by a 250-kv machine through a 1.5-mm Cu filter at a target distance of 50 cm; the daily dose per field was 250 r measured in air; the lymphatics in the supraclavicular and infraclavicular regions and in the axilla were irradiated, as well as

the main tumor, and the total dosage was 2,500 to 3,000 r in air per field. Treatments to the chest wall, if necessary, were given by a 120-kv machine with a filtration of 3 mm of Al and at a target distance of 30 cm; a single exposure was 400 r in air, and the total dosage to each field was 2,400 to 2,800 r. Skin changes with telangiectases, fibrosis of muscles and fat, pneumonitis, and lung fibrosis occasionally occurred as a result of the treatment. A total of 26 patients have survived over 2 years after the therapy, 10 of which are without evidence of disease; 2 patients without evidence of disease have survived over 8 years after therapy.

3341 The X-Ray Treatment of Uveitis. M. E. Alvaro. Trans. Pacific Coast Oto-Ophthalmological Soc. 29, 21-32(1948).

Inflammation causes contraction of arterioles and dilatation of capillaries; according to numerous investigators, x-ray irradiation produces dilatation of the small vessels. The author used x-ray treatment as complementary to routine medication in cases of uveitis and found that it gave good results in about 85% of all treated cases. He gave 50 to 80 r every 5 days for a total of 5 doses.

3342 A Study of the Effect of 2,3-Dimercaptopropanol (BAL) upon the Metabolism of Plutonium. Bergene Kawin and D. Harold Copp. AECD-2814, Jan. 23, 1950, Decl. Apr. 5, 1950. 8p.

The effects of 2,3-dimercaptopropanol (BAL) upon the metabolism of intramuscularly injected Pu(VI) in rats have been investigated. The use of BAL produced no significant alterations in the distribution and excretion of plutonium as compared to the pattern shown by control animals. The metabolism of plutonium does not appear to be related to sulfhydryl groups. On the basis of its ineffectiveness in changing the metabolism of plutonium, BAL does not appear to be an effective therapeutic treatment for plutonium poisoning. 10 references. (auth)

3343 An Interspecies Comparison of the Radiotoxicities of X Ray, Sr^{89}, and Pu^{239}. C. Ladd Prosser and Marguerite N. Swift. AECD-2828, June 1949, Decl. Apr. 18, 1950. 10p.

The 30-day LD_{50} for Sr^{89} on the basis of injected dose decreases with increasing animal size as shown by 7.8 μc/g for the mouse, through rat and rabbit, to 0.8 μc/g for the dog, and then increases to 1.3 μc/g for the goat. The series is similar when computed on the basis of the dose retained at time of death. Radiation lost outside the body is greater in small than in large mammals, but measurements in mice show such loss to be not more than 3% of total emitted radiation from Sr^{89}. The radiation sensitivity as indicated by LD_{50} for x-rays follows a different order from Sr^{89} sensitivity, the LD_{50} being highest in the rabbit, least in the dog, and intermediate in the mouse and rat. Calculation of Sr^{89} LD_{50} on the basis of skeletal weight increases the species differences. When the 30-day LD_{50} of Sr^{89} is corrected for retention and relative radiosensitivity (using the radiosensitivity of the mouse as a unit), the following series is obtained in μc/g: mouse 3.5, rat 2.48, rabbit 0.57, dog 0.57, and goat 0.98. By extrapolation from this series, the 30-day LD_{50} of Sr^{89} for man would be between 1.0 and 1.5 μc/g. The strontium is deposited in bone and has a range (50% of the β rays absorbed) of 0.72 mm in soft tissue. The

species differences in LD_{50} are interpreted on the assumption that some volume of marrow needs to be irradiated to cause death. The species series for Pu^{239}, the particles of which have a range of only about 40 μ in soft tissue, shows little variation in toxicity with size. The 30-day LD_{50} on the basis of retained dose in μc/g and corrected for relative radiosensitivity is: mouse 0.0412, rat 0.0399, and dog 0.0375. If the relative radiosensitivity is known, it is possible to extrapolate from one species to another for α-particle dosage, but not for lethal β-particle dosage. (auth)

3344 Action of Methyl Fluoroacetate on Respiration and Potential of Nerve. L. L. Boyarsky, A. D. Rosenblatt, S. Postel, and R. W. Gerard. Am. J. Physiol. 157, 291-8(1949) May.

In order to get evidence concerning the metabolic basis of nerve activity, correlated studies on the influence of fluoroacetate in the respiration and functional activities of nerve experiments were performed, using sciatic nerve preparations from frogs to test the conduction activity and respiratory activity under different conditions of poisoning. The results of experiments using sodium fluoroacetate and methyl fluoroacetate are presented graphically and discussed. The authors conclude from this study that the sodium preparation is almost inert with respect to the nerve, but that the methyl compound interferes with resting metabolism and leads to irreversible conduction block after a latent period during which the threshold gradually rises; fumarate and succinate protect against this action, but ethanol, acetate, pyruvate, α-ketoglutarate, and glucose are not effective. The authors consider that these findings emphasize the safety factor in nerve metabolism, the difference between nerve and muscle metabolism, and support the existence and functional importance of the tricarboxylic acid cycle in metabolism of nerve. 31 references.

3345 Administration of BAL in Selenium Poisoning. J. B. Belogorsky and Donald Slaughter. Proc. Soc. Exptl. Biol. Med. 72, 196-8(1949) Oct.

To test the toxicity of selenium and BAL and their synergistic effects, 112 male and female 6-week-old rats were divided into 12 groups as follows: 10 males and 10 females received 5 mg/kg interperitoneal doses of selenium; 10 males and 10 females received 10 mg/kg doses of selenium; 10 males and 10 females received 15 mg/kg intramuscular doses of BAL; 8 males and 8 females received 15 mg/kg BAL and 5 mg/kg doses of selenium; 8 males and 8 females received 7.5 mg/kg BAL and 5 mg/kg selenium doses; 10 males and 10 females received 15 mg/kg BAL for 20 days and then 15 mg/kg BAL and 5 mg/kg selenium doses. The doses were given daily until death or for 28 days, at which time all surviving animals were sacrificed, and the livers and kidneys were examined histologically. The results in terms of survival rates and a discussion of the histopathological findings are given. The authors conclude that: liver damage and death from selenium may be separate phenomena; BAL does not antagonize the toxicity of selenium; the SH groups furnished by BAL may prevent the liver damage due to the selenium, but do not completely detoxify the metal; and BAL enhances the toxicity of selenium for the kidney.

3346 The Assay of Acute Vapor Toxicity, and the Grading and Interpretation of Results on 96 Chemical Compounds. Charles P. Carpenter, Henry F. Smyth, Jr.,

and Urbano C. Pozzani. J. Ind. Hyg. Toxicol. 31, 343-7(1949) Nov.

After preliminary tests to eliminate compounds which will not cause death of more than one rat during an 8-hr exposure, extensive work on concentration variables considered independently of vapor pressure was performed. Male or female rats were divided into groups of 6, exposed to a known concentration of one of the vapors for 4 hr, observed continuously for blinking, lacrimation, nasal irritation, roughening of the coat, excessive salivation, accelerated respiration, gasping, tremors, convulsions, loss of coordination, prostration, narcosis, and death, and those which survived were sacrificed after 14 days. Autopsies were performed, and pathological changes in lung, liver, spleen, adrenals, kidney, and testis were noted in 2 rats from each group which died during the observation period and in 2 which survived for 14 days. The method is completely described, and results in terms of concentrations which killed 2, 3, or 4 of the 6 rats are given in 16 group ranges for lethal effects in 4 hr and in 19 group ranges for observation-period deaths. Among the compounds tested which killed 2, 3, or 4 animals in 4-hr exposures were: ethyl fluoride, 256,000 ppm; 1-chloro-1, 1-difluoroethane and 1,1-difluoroethylene, 128,000 ppm; 1,1-difluoroethane, 64,000 ppm; chlorotrifluoroethylene and propylene fluorohydrin, 4,000 ppm; tetrachloro tetrafluoro propane, 16 ppm.

3347 BAL and Testosterone Propionate in the Treatment of Mercuric Chloride Poisoning. Richard P. Levy, Thomas W. Moir, and Max Miller. Proc. Soc. Exptl. Biol. Med. 73, 498-500(1950) Mar.

Male albino rats weighing between 100 and 250 g were poisoned with mercuric chloride and treated with BAL, testosterone propionate, or a combination of both. It was demonstrated that in rats, as in other species, BAL effectively combats the toxicity of mercuric chloride. Testosterone propionate over a wide range of doses administered after mercuric chloride had no apparent effect upon the toxicity, either alone or in combination with BAL. A histological study of the kidneys failed to demonstrate any stimulating effect of testosterone on the damaged tubules. The definite protection afforded by BAL could not be correlated with any detectable microscopic changes in the tubules.

3348 Beryllium Inhibition of Regeneration. I. Morphological Effects of Beryllium on Amputated Fore Limbs of Larval Amblystoma. Charles Stead Thornton. J. Morphology 84, 459-84(1949) May.

Larvae of Amblystoma opacum and punctatum strains were subjected to limb amputation and were then totally immersed in a solution of beryllium nitrate, $Be(NO_3)_2.3H_2O$, not exceeding an N/7 concentration for a period of up to 2 min; the larvae were promptly removed from the beryllium solution, washed for 10 min in running water, and then returned to their individual aquaria and observed over a period of time for limb regeneration. It was found that the limb regeneration could be inhibited by N/7 beryllium nitrate solution, but the extent and nature of this inhibition depended on the size of the larvae and the limb level at which the amputation had been made. The effect of beryllium on the limb tissues and the correlation between rapid wound healing and the absence of limb regression in beryllium-treated limb stumps are discussed. 22 references. (auth)

3349 Cardiodepressive Effects of Mercurial Diuretics. Cardioprotective Value of BAL, Ascorbic Acid and Thiamin. Arthur Ruskin and John E. Johnson. Proc. Soc. Exptl. Biol. Med. 72, 577-83(1949) Dec.

In order to study the specific conductive and electrical systole effects of mercuhydrin in isolated rabbit heart and to compare its myocardial toxicity with other substances, as well as to evaluate the detoxifying effects of BAL, ascorbic acid, and thiamin used before and after mercurial compound administration, electrocardiographic analyses were performed on the material under carefully controlled and quantitative conditions. The results are presented graphically in terms of the elements of the electrocardiograms and are discussed. The authors conclude, on the basis of this study, that preliminary BAL, ascorbic acid, and thiamin (in that order of efficacy) raised the cardiolethal and blocking doses of mercuhydrin and (in that order) also reversed the cardiac effects when they were administered after the mercuhydrin.

3350 Cardiodepressive Effects of Thiomerin: Cardioprotective Attempts with BAL, Ascorbic Acid and Thiamin. Arthur Ruskin and John E. Johnson. Proc. Soc. Exptl. Biol. Med. 72, 572-6(1949) Dec.

In order to obtain data on the cardiotoxic and cardiolethal dosage levels of thiomerin and to determine the cardioprotective effects of BAL, ascorbic acid, and thiamin used before and after thiomerin in the isolated perfused rabbit heart, controlled electrocardiographic analyses were performed on the material in tests of conduction delay, rapid asystole, and over-all effects. Some of the electrocardiograms are presented; the results in terms of R-R intervals, P-R intervals, and Q-T intervals are presented graphically and discussed. Some of the conclusions from this study were: BAL approximately doubled the cardiolethal dosage of thiomerin, but the vitamins had no apparent effect; BAL reversed the deleterious conduction effects of very large doses of thiomerin; and ascorbic acid and thiamin reversed the effects in relatively smaller doses of the monothiol.

3351 A Consideration of the Roentgen Diagnosis of Chronic Pulmonary Granulomatosis of Beryllium Workers. Agrippa G. Robert. Am. J. Roentgenol. Radium Therapy 63, 467-87(1950) Apr.

The appearance of a new disease, chronic pulmonary granulomatosis, occurring in beryllium workers and characterized primarily by dyspnea, cough anorexia, loss of weight, and roentgenologically visible lesions within the lungs is described. The incidence, clinical features, and pathology of the disease in question are briefly surveyed; its roentgen manifestations are detailed, and its differential diagnosis is described. It is suggested that more frequent serial roentgenograms of all exposed personnel and more careful "follow-up" studies of those individuals now lost to observation would add considerably to our current knowledge of the epidemiology and behavior of the disease and would accelerate an eventual understanding of the problem as a whole. 34 references. (auth)

3352 Distribution of the Radioactive Substance following Intravenous Injection of Peteosthor. I. The Thorium X and Thorium B Content in the Organs of the Rat.

Kurt Ernst Scheer. Ärztl. Forsch. 4, I/161-I/164 (1950) Mar. 25 (in German).

Two groups of 8 rats each received intravenous injections of pure thorium or peteosthor. About 24 hr later the animals were sacrificed, and their tissues were examined for radioactivity; the content of Th X and Th B were computed. It was found that there was a clear distinction in the content of Th X and Th B in those organs which received thorium from those which received the peteosthor, but the livers of the animals treated with the latter substance contained about twice as much Th B. The testicles of all animals showed a low activity. The author concludes that the possible use of pure thorium as a clinical tool ought to be investigated.

3353 The Effect of Dimercaprol (B.A.L.) in Acute Iron Poisoning. N. D. Edge and G. F. Somers. Quart. J. Pharmacol. 21, 364(1948).

The effect of BAL in acute experimental iron poisoning in mice was investigated by administering orally up to 710 mg/kg of ferrous sulfate or up to 840 mg/kg of ferrous chloride preceded or followed by 840 to 1,050 mg/kg doses of BAL; intravenous injections of 13.8 mg/kg of the sulfate or 18.5 mg/kg of the chloride were also tested to determine the minimum lethal doses. A BAL-iron complex was prepared and injected intravenously which had a minimum lethal dose corresponding to that of the iron salt preceded by BAL. The authors conclude that BAL gave slight protection if administered 15 min before the iron, but made the animals more susceptible if administered after the iron dose when the oral technique was used; the BAL significantly increased the susceptibility of the iron administered intravenously irrespective of time.

3354 Experimental Fluorosis in Rats. Leo Spira. Exptl. Med. and Surg. 7, 134-49(1949) May-Aug.

In order to determine the general systemic effects of chronic F poisoning in rats, 12 groups of young male rats were submitted to peroral administration of gradually increasing concentrations (up to 340 ppm) of F in the drinking water. The animals were observed over a period of about 11 months for dental, dermatological, and behavioral differences, and their response to F removal and calcium administration in large doses. The observations are given in detail and discussed. 32 references.

3355 Inability of 2-3 Dithiopropanol (BAL) to Protect the Liver against Toxic Action of Uranium Nitrate. W. deB. MacNider. Proc. Soc. Exptl. Biol. Med. 68, 160(1948).

The author has shown that doses of BAL (10%, benzyl benzoate 20%, in peanut oil) equivalent to 15 mg/kg, when administered subcutaneously to dogs for 8 days, were ineffective against the hepatotoxic action of 4 mg/kg of uranium nitrate; instead, it tended to increase the toxic effects. The livers showed diffuse necrosis with advanced fatty degeneration.

3356 Latent Tetany Caused by BAL (2:3 Dimercaptopropanol). Brian Russell, Bernard Green, and L. G. R. Wand. Lancet 255, 169-74(1948) July 31.

Studies of the Ca, Mn, Na, and K metabolism were done on 18 patients and controls receiving 0.75 to 6.11 mg/kg of BAL in order to test the possibility of a latent tetany being caused by BAL administration. Data and results on all

cases are given; the authors conclude that a latent tetany of the low-magnesium and low-calcium type occurs in cases of BAL use, but may be safely eliminated by high calcium, magnesium sulfate, and vitamin D intake.

3357 Subacute Toxicity of Radioactive Phosphorus as Related to the Composition of the Diet. W. E. Cornatzer, George T. Harrell, Jr., David Cayer, and Camillo Artom. Proc. Soc. Exptl. Biol. Med. 73, 492-5(1950) Mar.

In the present investigation the subacute toxicity of P^{32} given parenterally to mice (in one dose in the form of Na_2HPO_4) was studied in relation to the possibility that changes in the composition of the diet might modify the action. It was found that in mice maintained on a 10% casein, 32% fat diet, the LD_{50} dose at the 21st day was 4 to 6 μc of P^{32}/g of body weight; neither the fatty infiltration of the liver or its prevention (by supplementing the diet with choline) changed the survival figures. The survival time of the mice was highest when they were maintained on a diet low in fat and protein and was significantly decreased when the level of either the fat or the protein or both was increased in the diet. Enrichment of the diets with inorganic phosphate seems to afford a moderate degree of protection against the injurious action of P^{32}.

3358 Toxic Fluorine Compounds Containing the C-F Link. Part II. Fluoroethanol and Its Derivatives. B. C. Saunders, G. J. Stacey, and I. G. E. Wilding. J. Chem. Soc. 1949, 773-7(1949).

Fluoroethanol proved to be a lethal inhalant similar to methyl fluoroacetate (MFA). A concentration of 0.29 mg/liter (10-min exposure) caused the death of 62% of a group of rabbits, whereas 0.14 mg/liter killed 38%, all deaths occurring within 24 hr. The 1-chloro- and the 1-bromo-2-fluoroethane are not toxic. Only the fluoroacetaldehyde is as toxic as MFA.

3359 The Value of Beryllium Determinations in the Diagnosis of Berylliosis. F. R. Dutra, J. Cholak, and D. M. Hubbard. Am. J. Clin. Path. 19, 229-34(1949) Mar.

In order to establish supportive diagnostic techniques in cases of suspected acute or chronic berylliosis, urine, blood, renal calculi, lung, and other tissues were examined in 48 cases of occupational and nonoccupational berylliosis, in some of which the presence of the disease was not indicated. Data from these cases are tabulated, and graphs of urine beryllium content of 2 patients receiving BAL therapy for acute beryllium pneumonitis are given over 11- and 21-day periods. The authors conclude from this study that the dianosis may be supported by urine determinations, especially in nonoccupational berylliosis, although beryllium may be found in the urine of patients with no symptoms of berylliosis; a few urine determinations are not sufficient to rule out berylliosis, since the excretion varies from day to day. Post-mortem beryllium determinations of tissues yield appreciable amounts from lungs, liver, spleen, kidney, and bone.

3360 On Radioactive Drugs. B. M. Tolbert. UCRL-643, Mar. 29, 1950. 9p.

In this abstract of an address before the Biochemical and Organic Group meeting of the California Section of American

Chemical Society, Feb. 13, 1950, the synthesis of the C^{14}-labeled compounds Methadone, codeine, Demerol, stilbamidine, and acetylcholine is reviewed. All preparations were carried out on a 20 mmole or less scale. Some characteristics of these compounds in biological work are discussed, in particular their mode of excretion.

3361 The Path of Oxygen in Photosynthesis. G. D. Dorough and M. Calvin. UCRL-645, Mar. 31, 1950. 16p.

An experiment is described in which an attempt was made to follow the path of oxygen in photosynthesis by the use of O^{18} as a stable tracer and green algae as the plant specimen. The results of the experiment were regarded as inconclusive.

3362 The Absorption of Barium Sulfate and Non-Absorption of Zirconium Dioxide From the Gastrointestinal Tract. Lathan A. Crandall, Jr. Gastroenterology 13, 513-26(1949) Dec.

The absorption of barium after the oral administration of barium sulfate to rats was demonstrated by the administration of radioactive Ba^{140} as a tracer followed by the determination of the radioactivity of the rat-carcass ash and was confirmed by the spectrographic determination of barium in carcass ash of rats fed ordinary $BaSO_4$. Control studies using zirconium dioxide showed that no detectable amount of the latter material was absorbed, indicating that the apparent absorption of barium could not be attributed to faulty technique. Certain properties of zirconium dioxide which invite consideration of its use in roentgenologic investigations of the gastrointestinal tract are discussed.

3363 Age as Affecting the Osmotic and Mechanical Fragility of Dog Erythrocytes Tagged with Radioactive Iron. W. B. Stewart, J. M. Stewart, M. J. Izzo, and L. E. Young. J. Exptl. Med. 91, 147-59(1950) Feb. 1.

Radioactive iron (Fe^{55} and Fe^{59} in gelatin) was administered intravenously to 3 normal dogs, in 0.87-, 30-, and 3.65-mg amounts, in order to tag a group of erythrocytes of approximately known age; 2 of the dogs had previously been bled. The osmotic fragility of the newly formed tagged cells was significantly greater than that of the general cell population during the first few days after injection of the iron, while the mechanical fragility of the young cells was less than that of the general red cell population. As the cells aged and approached the end of their life span, their susceptibility to destruction by trauma inflicted by rolling glass beads exceeded that of the general cell population. A decrease in circulating radioactive iron was observed in each experiment soon after the increased mechanical fragility of the tagged cells, the lowest point on the iron curve being observed at 119, 119, and 122 days, respectively, after injection of the iron. The osmotic behavior of the old cells was not distinctive. It is noted that increased mechanical fragility of senescent cells suggests that the life span of erythrocytes may be limited at least in part by changes within the cell which render it more susceptible to destruction by mechanical wear and tear in the circulation. It is emphasized, however, that the trauma produced by rolling glass beads may be quite unlike that inflicted upon red cells in vivo. Estimates of the life span of dog erythrocytes obtained in this way agree with those provided by other methods. 28 references. (auth)

3364 Biological Studies with Arsenic^{76}. I. Preparation of Arsenic^{76} by Pile Irradiation of Cacodylic Acid. R. L. Straube, W. B. Neal, Jr., T. Kelly, and H. S. Ducoff. Proc. Soc. Expti. Biol. Med. 69, 270-2 (1948) Nov.

A method for the preparation of As^{76} by neutron pile irradiation of cacodylic acid is described. The yields of As^{76} from pile-irradiated samples of 300 to 800 mg of the acids by Szilard-Chalmers reaction are tabulated and compared to the yields from pile irradiation of several other compounds. From the data the authors conclude that the wide variation in specific activity is due to the nonuniformity of time and power levels of pile irradiation and the fact that the activities were calculated to the time of preparation of the arsenic solution; the specific activity is 15.0, as compared to 0.5 and 0.1 for the same type of preparation using irradiated arsenic trioxide and arsenilic acid, respectively. In addition to the high specific activity noted, irradiation of cacodylic acid yields a solution of high total activity, which is a function of the high neutron capture cross section for As^{76}.

3365 Biophysical Research Methods. F. M. Uber, ed. San Diego, Navy Electronics Laboratory, 1950. 680p.

This book contains chapters on various topics in biophysics by experts in the field, including the following: X-rays and X-irradiation, J. W. Gowen; Electrons, Neutrons, and Alpha Particles, L. H. Gray; Stabie Isotopes as Tracers, F. M. Uber; and Radioactive Tracers, A. F. Voigt.

3366 Comparison of Results of Measurement of Red Blood Cell Volume by Direct and Indirect Technics. H. S. Mayerson, Champ Lyons, William Parson, Robert T. Nieset, and W. V. Trautman, Jr. Am. J. Physiol. 155, 232-8(1948) Oct.

In order to test the discrepancy noted between the radioactive iron technique and the plasma-dye-hematocrit (T-1824) technique for determining the volume of circulating red blood cells, concomitant measurements of red cell mass and plasma volume were made, using the P^{32} technique and the T-1824 technique in 10 normal and 35 hospitalized individuals. The individuals were observed under basal conditions; 10 cc of blood was taken from the antecubital vein; 5 cc of red cells labeled with P^{32} was injected; after rinsing, 5 cc of T-1824 solution was injected; after 10 min, 15 cc of blood was taken from the opposing antecubital vein and divided into two samples for the determinations. Data and results are given and discussed; the authors conclude that whole blood volume can be measured with an average discrepancy of less than 5% by the T-1824 method if a hematocrit correction factor of 0.96 is used.

3367 Concentration of Iodine in the Human Stomach and Other Tissues as Determined with Radioactive Iodine. Richard E. Goldsmith, Charles D. Stevens, and Leon Schiff. J. Lab. Clin. Med. 35, 497-503 (1950) Apr.

The distribution of I^{131} in the tissues of 14 subjects injected intravenously with varying quantities of radioactively labeled sodium iodide was measured; these subjects died from 3 to 159 hr after the administration of the iodine. The thyroid gland contained much higher concentrations of I^{131} than did the blood serum; stomach tissue from 10 of 13

subjects sampled contained two or more times the concentration of I^{131} present in the blood serum; none of the other nine tissues examined showed similar ability to concentrate the I^{131}. In tissues other than the stomach and thyroid, I^{131} was distributed like chloride only in those subjects who received large quantities of sodium iodide and who died shortly thereafter. 24 references. (auth)

3368 Conversion of Lactate to Liver Glycogen in the Intact Rat, Studied with Isotopic Lactate. Victor Lorber, Nathan Lifson, Harland G. Wood, Warwick Sakami, and Walton W. Shreeve. J. Biol. Chem. 183, 517-29(1950) Apr.

$CH_3 \cdot C^{13}HOH \cdot COONa$, $C^{13}H_3 \cdot C^{13}HOH \cdot COONa$, and $C^{14}H_3 \cdot C^{13}HOH \cdot COONa$ have been fed to rats, and the resulting liver glycogen was isolated and degraded; the distribution of isotope in the glucose chain was determined. The results have been interpreted in terms of the reactions of glycolysis and the tricarboxylic acid cycle, with which schemes they appear to be in general agreement. The results with lactate labeled in the α or β carbon indicate that of the administered lactate carbon that was deposited as liver glycogen probably less than one-sixth entered the glycogen directly via the reactions of glycolysis without prior passage through reactions involving randomization of isotope between the α- and β-carbons. 15 references. (auth)

3369 Conversion of Propionate to Liver Glycogen in the Intact Rat, Studied with Isotopic Propionate. Victor Lorber, Nathan Lifson, Warwick Sakami, and Harland G. Wood. J. Biol. Chem. 183, 531-8(1950) Apr.

Isotopic propionate $CH_3 \cdot CH_2 \cdot C^{13}OONa$, $C^{13}H_3 \cdot CH_2 \cdot COONa$, and $C^{14}H_3 \cdot C^{13}H_2 \cdot COONa$) has been fed to fasted rats, and the resulting liver glycogen was isolated, hydrolyzed to glucose, and degraded. The isotope from the carboxyl group of propionate has been found to give a detectable labeling only in carbon atoms 3 and 4 of the glucose, while propionate containing the isotope in the α or β position gives rise to glucose labeled predominantly and equally in carbons 1, 2, 5, and 6. The results indicate that propionate gives rise to pyruvate, but that in the process the α and β carbons of the propionate lose their orientation and become equally distributed between the corresponding groups of pyruvate. Some possible explanations for this finding are advanced. 18 references. (auth)

3370 Demethylation of C^{14}-Labelled Codeine in the Rat. T. K. Adler and M. E. Latham. Proc. Soc. Exptl. Biol. Med. 73, 401-4(1950) Mar.

Adult male and female albino rats of the Slonaker-Wistar strain received a subcutaneous injection of 40 mg of codeine labeled with C^{14} (which contained 0.9 μc of activity per milligram) and were placed in a metabolism chamber where the expired CO_2 was collected for periods of 1 to 31 hr and analyzed for the C^{14}. Two hours after the injection, blood samples were taken, and in some animals tissues were analyzed for radioactive CO_2-HCO_3. In vitro studies were also performed in which rats were killed, tissues were quickly removed, and liver, kidney, lung, spleen, brain, intestine, and muscle samples were prepared; blood was withdrawn and also studied. The slices were incubated in Krebs-Ringer solution containing 630 μg of the labeled

BIOLOGY AND MEDICINE

codeine; oxygen saturated with water vapor was admitted, and the CO_2 produced was collected; experiments with blood omitted the Krebs-Ringer solution. It was found that the labeled codeine was demethylated both in vitro and in vivo, the labeled methoxy group being oxidized to $C^{14}O_2$, which was expired. The site of the demethylation process was found to be primarily the liver; 40% of the injected dose was demethylated in 6 hr. Transmethylation was not demonstrated in vitro. (auth)

3371 Determination of Thyrotrophin by Means of Radioactive Phosphorus. Ulf Borell and Hjalmar Holmgren. Acta Endocrinol. 3, 331-41(1949).

A total of 87 male guinea pigs were kept at a uniform temperature (30 to 32°C) and given daily injections of thyrotrophin for two days; radioactive phosphorus, P^{32}, in a dose of 0.5 mc dissolved in a 5% glucose solution was injected intraperitoneally into all the animals 40 min before they were sacrificed. The thyroid lobes were studied histologically and analytically. It was found that the amount of radioactive phosphorus in the thyroid gland increased markedly after the injections of thyrotrophin; the number of labeled phosphate atoms in the thyroid was multiplied nearly tenfold, whereas the cell height was barely doubled. A distinct increase is produced even by small amounts of thyrotrophin; moreover, the method is quite as accurate as that which depends on the measurement of cell height. The radioactive phosphorus in the thyroid progressively increased after injections of thyrotrophin within a wide range of dosage. It is concluded that the method used seems to be valuable in the assay of thyrotrophin; it is objective and easily applied.

3372 The Direct Oxidation of Adenine in Vivo. Aaron Bendich, George Bosworth Brown, Frederick S. Philips, and J. B. Thiersch. J. Biol. Chem. 183, 267-77(1950) Mar.

The deposition of 2,8-dioxyadenine in the kidneys of the rat following the administration of adenine has been studied through the use of N^{15} and C^{14}. The authors conclude that the identity of the product has been confirmed. Evidence that 2,8-dioxyadenine arises as a result of a direct in vivo oxidation of adenine is presented: the resulting lesion is described and is termed in this article "adenine kidney." It was found that the 2,8-dioxyadenine also deposits in rat kidneys when either isoguanine or 8-oxyadenine is administered, but none could be demonstrated after the administration of 3,8-dioxyadenine itself. It was also found that intraperitoneally injected adenine serves as a precursor of nucleic acid adenine and guanine; isoguanine was found to be inactive in this respect.

3373 Distribution of Radioactive S^{35} of Thiopental (Pentothal) in the Rabbit and the Cat. J. D. Taylor, R. K. Richards, and D. L. Tabern. Anesthésia et analgésia 29, 101-5(1950) Mar.-Apr.

Rabbits were injected intravenously with 20 mg/kg of radioactive pentothal containing S^{35} in order to study the distribution of the anesthetic. Blood samples were taken at 1-, 5-, and 10-min intervals after the injection; the animals were the sacrificed, and their organs were analyzed for radioactivity. Cats were also injected intravenously with 20 mg/kg of the labeled anesthetic, and at the end of 5,

10, 30, and 60 min, the cats were killed, and the cerebellum (also other parts of the brain) was analyzed for radioactivity. The analytical methods and procedures are described in detail. Ten minutes after the injection, the pentothal was found in all tissues of the body of the rabbit, with the largest amounts in the liver and kidney. No significant difference was found in the radioactivity of the cortex, white matter, cerebellum, and thalamus of the cats tested. An unexplained failure of the brain content to show lower values 10 min after injection than 5 min after was observed. The rate of decrease of the pentothal after 10 min was the same for all parts of the brain.

3374 Distribution of Selenium in Serum Proteins and Red Blood Cells after Subcutaneous Injection of Sodium Selenate Containing Radioselenium. Kenneth P. McConnell and Betty J. Cooper. J. Biol. Chem. 183, 459-66(1950) Apr.

Studies were made on the distribution of selenium in the blood, serum proteins, and red blood cells of the dog after subcutaneous injections of radioselenium, Se^{75}, as sodium selenate. It was found 24 hr after the last of three injections that the whole blood activity in red blood cells for four dogs averaged 79%, while in plasma it averaged 22%; it was calculated that 2.0 to 3.9% of the selenium administered was present in the total circulating blood. The results obtained from serum protein fractionation revealed that selenium was present in albumin, globulin, euglobulin, and pseudoglobulin and that the amount of selenium in the various fractions when expressed as micrograms of selenium per gram of protein was similar, but not identical. Results from dialysis studies indicated that there was a certain amount of selenium fixation in blood proteins which existed in a fairly stable protein-like combination. It has been shown that selenium is present in crystalline hemoglobin and hemin and in globin; the amounts of selenium in hemin, when calculated on the gram basis, are greater than in globin. (auth)

3375 The Entry of Radioactive Phosphorus into the Phospholipids of the Brain. R. M. C. Dawson and D. Richter. J. Physiol. 109, 21P-2P(1949) Sept.

Changes in in vivo metabolism of the brain with functional activity were studied by measuring the rate at which P^{32} entered the mouse brain from the blood and was synthesized into nucleoproteins and phospholipids. No significant differences were noted for sex and age differences in animals over 2 months old; no change in P^{32} uptake into acid-soluble or nucleoprotein fraction, but a 25% fall in the rate of phospholipid P^{32} synthesis was noted in 6 animals after a 3-hr period of emotional excitement and also after direct electrical stimulation of the brain.

3376 The Fate of Uric Acid in Man. William Geren, Aaron Bendich, Oscar Bodansky, and George Bosworth Brown. J. Biol. Chem. 183, 21-31(1950) Mar.

The isolation of uric acid, urea, and ammonia from human urine is described, and experiments determining the uric acid content in normal human urine by means of the isotopic dilution method utilizing N^{15} and by colorimetric methods are presented. It was found that orally administered uric acid is extensively degraded, whereas intravenously administered uric acid is excreted essentially unchanged. The pool of available uric acid in man was found to be somewhat less than 1 g and its half-life to be less than 1 day.

BIOLOGY AND MEDICINE

3377 The In Vitro Conversion of C^{14}-Labeled Glucose to Fatty Acids. S. S. Chernick, E. J. Masoro, and I. L. Chaikoff. Proc. Soc. Expti. Biol. Med. 73, 348-52(1950) Mar.

C^{14}-labeled glucose was used in the present investigation to study lipogenesis by surviving slices of liver, kidney, and muscle which were prepared from rats that had been fed a high carbohydrate diet. The rats were sacrificed after maintenance on the diet for 2 weeks, and the required tissues were rapidly removed and placed in Ringer-bicarbonate solution to which was added the labeled glucose; the preparation was then gassed with a mixture of 95% O_2 and 5% CO_2 and incubated for 3 hr with gentle shaking. The details of the methods and procedures involved are presented. From these studies it was found that there was a conversion of the C^{14}-labeled glucose to fatty acids by the surviving slices of liver, kidney, and diaphragm tissue; the recoveries of fatty acid C^{14} were 10 times as great with the liver slices as with the diaphragm of kidney tissue, but were one-sixth to one-tenth as much as the recoveries of the C^{14} converted to CO_2. An incubation flask is described which, the authors conclude, is suitable for the collection of CO_2 evolved in tissue-slice experiments from C^{14}-labeled compounds.

3378 Iron Supplies in Foetal and Newborn Rats. W. F. Widdas. J. Physiol. 109, 32P(1949) Sept. (See also NSA 4-2235)

Experiments on rats using Fe^{59} indicate that the full-term fetus does not store Fe, but the mother may supply twice as much Fe via milk in the first 21 days postpartum than she does during pregnancy. Factors influencing the iron-weight ratio are discussed. 16 references.

3379 Localization of Radioactive Materials in the Phantom Brain. Mark A. Griffin, Jr., Philip P. Goland, and Richard H. Chamberlain. Nucleonics 6, 37-43(1950) Apr.

This paper is concerned with the use of tracer localization in encephalography. Marvin and Moore (Nucleonics 3, 63 (1948)) who used a phantom to explore the physical limitations of tracer localization, recommend that the counter should be held normal to the skull and that symmetrical counting positions should be employed. The authors disagree with this view and prefer a rectangular system of coordinates to locate concentrations of γ-ray emitters, both on theoretical grounds and on the basis of an experimental study carried out by them with a phantom brain set into a skull.

3380 The Measurement of the Iodine-Accumulating Function of the Human Thyroid Gland. F. Raymond Keating, Jr., J. C. Wang, Thomas J. Luellen, Marvin M. D. Williams, Marschelle H. Power, and William M. McConahey. J. Clin. Invest. 28, 217-27 (1949) Mar.

A discussion of previous work is presented, concluding with the rationale of the problems considered in this report: an empirical method for measuring in vivo the quantity of radioiodine, I^{131}, collected by the human thyroid; a presentation

of methods for estimating iodine accumulation from this data; a comparison of this method with others which are derived from in vivo observations; and studies of urinary excretion after oral administration of I^{131}. The method of measuring thyroid collection of I^{131} is described, and data using this method on 30 humans are tabulated; accumulation values from this and other methods are compared for thyroid and other tissue determinations; hypo- and hyperthyroidism associated with various conditions such as tumors and goiters and euthyroidism are considered in terms of excretion, collection, and accumulation factors. An accumulation rate, defined as the proportional rate at which the thyroid accumulates iodine, is discussed, and the authors conclude that this quantity may be less significant as a measure of accumulation than thyroidal iodide clearance, which is determined directly in vivo from observations over the thyroid obtained simultaneously with serum I^{131} concentration determinations. 15 references.

3381 Measurement of the Rate of Venous Blood-Flow in the Legs of Women at Term and in the Puerperium, Using Radioactive Sodium^{24}. H. Payling Wright, S. B. Osborn, and Denise G. Edmonds. J. Obstet. Gynaecol. Brit. Empire 56, 36-40(1949) Feb. (See also NSA 4-2966)

In a series of experiments to determine the venous blood flow rate in the legs of women, a series of 50 women, including 39 primigravidae, were examined as follows: the leg was immersed in water at 40°C for 10 min to ensure vasodilatation; 1 cc of sterile saline containing 5 to 10 μc of Na^{24} was administered intravenously in the foot, and the time for the material to reach the groin was determined by a counter. The first determination was made in this way in all cases in the first stage of labor, and the second was made 4 to 10 days in puerperium. The results are given and discussed. The authors conclude that, compared with nonpregnant women, there was a large retardation of venous flow in the legs during labor, but in puerperium the flow rapidly returned to normal.

3382 Mineralization of the Growing Tooth as Shown by Radio-Phosphorus Autographs. L. F. Bélanger and C. P. Leblond. Proc. Soc. Expti. Biol. Med. 73, 390-1(1950) Mar.

An injection of carrier-free P^{32} was administered to 4-day-old hamsters (soon after the appearance of dentin and enamel in the germs of the first and second molars) in order to study the deposition of the isotope; the animals were sacrificed 1 hr, 6 hr, 1 day, 2 days, or 4 days later, and the jaws were fixed in a neutral formalin-alcohol solution, embedded in colloidin, sectioned, and autographed. The dentin and enamel, but not the soft tissues, showed autographic reactions. These were attributed to the presence of P^{32} in a form sufficiently insoluble to be retained in the sections during the radioautographic procedure. At 1 and 6 hr after injection, diffuse and localized reactions were noted; the diffuse reactions pointed out the presence of "extracellular" spaces throughout the dentin and enamel for the diffusion of the circulating phosphate. A gradual decrease in the diffuse reaction occurred from the first day on and indicated replacement of radioactive phosphate with inactive phosphate. Other findings are discussed, and it is concluded that the evidence indicates that the formation of enamel is due to the elaboration by the ameloblasts of an organic matrix which is mineralized much later. No information as to why the crystals of dentin and enamel form in the indicated areas was obtained.

3383 The Movements of Radioactive Sodium During Nervous Activity. R. D. Keynes. J. Physiol. 109, 13P(1949) Sept.

The rates of passage of radioactive Na and K through nerve membranes of single Sepia axons were studied. The rate of entry of Na^{24} was increased 15 times by stimulation of 100 impulses/sec but the net flow was less than this since an indeterminate outward flow rate was also increased. The author concludes that Na permeability increases during excitation, which is confirmatory evidence for theories of the role of Na in nervous conduction.

3384 The Origin of the Methyl Group of Epinephrine. Elizabeth B. Keller, R. A. Boissonnas, and Vincent du Vigneaud. J. Biol. Chem. 183, 627-31(1950) Apr.

Epinephrine has been isolated by a "washing-out" technique from the adrenals of two rats which received methionine containing C^{14} in the methyl group. The epinephrine was found to contain a significant amount of C^{14}. That this C^{14} was incorporated in the epinephrine and not present as an impurity was shown by the fact that the specific activity of the epinephrine remained constant on recrystallization and on the subsequent conversion of the epinephrine to iodoadrenochrome. It has been concluded from these results that the methyl group of epinephrine can be derived from dietary methionine in vivo. 13 references. (auth)

3385 The Permeability of the Human Placenta to Water and the Supply of Water to the Human Fetus as Determined with Deuterium Oxide. L. M. Hellman, L. B. Flexner, W. S. Wilde, G. J. Vosburgh, and N. K. Proctor. Am. J. Obstet. Gynecol. 56, 861-8 (1948) Nov.

Investigations were carried out to determine whether the water permeability of the human placenta changes during gestation, whether it is the same in the human as in the guinea pig, what the relative permeabilities of sodium and water are, and whether the human fetus receives amounts of water greatly in excess of that used in growth. Seven patients at various periods of pregnancy, who were having the pregnancy surgically terminated for various reasons, received 40 to 70-cc intravenous injections of 95% D_2O (made isotonic with NaCl) administered into both antecubital or both anterior tibial veins simultaneously. The injection duration, the delivery time, and time of clamping the umbilical cord were noted; the details of the method of determining transfer are given; the results are tabulated, graphed, and discussed. The authors conclude that: there is a fivefold increase in transfer rate of water per unit weight of placenta from 14 to 40 weeks during gestation; the transfer coefficient for water is about five times that for sodium; the permeability to water in the guinea pig is two times that in the human; the human fetus receives 700 to 3,800 times as much water as is incorporated into the tissues.

3386 Phosphorus Metabolism of the Mouse Brain as Indicated by the Use of Radiophosphorus. Dominic Dziewiatowski and David Bodian. J. Cellular Comp. Physiol. 35, 141-50(1950) Feb.

Subsequent to the intraperitoneal administration of disodium hydrogen phosphate, labeled with P^{32}, the activity of the P^{32} was followed in the inorganic, acid-soluble, phospholipid, and residual ("protein-bound," including nucleoprotein) phosphorus fractions of mouse blood and brain. In all 4 phosphorus fractions of the blood the activity was found to decrease markedly between the 6th and 216th hr. In the brain the uptake of the P^{32} into any of the phosphorus fractions was slight. The change in the inorganic phosphorus fraction was not great between the 6th and 216th hr; in the phospholipid and residual phosphorus fractions the P^{32} activity increased 72 to 120 hr later with little change thereafter. (auth)

3387 The Phosphorus Turnover of Carcinoma of the Human Stomach as Measured with Radioactive Phosphorus. John Schulman, Jr., Marlene Falkenheim, and Seymour J. Gray. J. Clin. Invest. 28, 66-72(1949) Jan.

Controlled experiments were set up to determine the total phosphorus turnover in carcinoma of the human stomach and to determine whether any change in the metabolism was due to a particular group of compounds such as the acid-soluble, the lipid, or the protein fractions of the total P turnover. Nine patients, about to undergo total gastrectomy for malignant and nonmalignant duodenal or gastric diseases, received 1 mc/lb body weight of aqueous solution of $KH_2P^{32}O_4$ about 36 hr before the surgery; samples of nonmalignant mucosa from the stomach and duodenum in several locations, samples of the carcinoma, and comparative samples at sites outside the malignant area were taken and prepared for analysis. Details of the procedure are given; the results are tabulated in terms of time, diagnosis, P^{32} content of the total phosphorus and the various fractions as found in each area, and biological concentration coefficients of various areas; the findings are extensively discussed. The authors conclude from this study that: the P turnover by gastric carcinoma is 45% greater than that of normal mucosa; the protein P turnover is greater by 124%, and the lipid P is greater by 45%; the increase is found only in the tumor, with no evidence of it in the surrounding tissue; the total mucosal P content is the same for normal and cancerous stomachs.

3388 Proceedings of the 41st Annual Meeting of the American Society for Clinical Investigation held at Atlantic City, N. J., May 2, 1949. J. Clin. Invest. 28, 764-820(1949) July.

Among the papers presented were the following: A Method for Estimating, Preoperatively, the Function of Thyroid Tumors; Its Significance in the Diagnosis and Treatment, Brown M. Dobyns and Bengt Skanse; Studies with a New Method for Quantitative Measurement of I^{131} Content of the Thyroid Gland in Man, A. Stone Freedberg, Alvin Ureles, and Marvin Van Dilla; An Isotopic Study of Porphyrin and Hemoglobin Metabolism, in a Case of Porphyria, Moises Grinstein, Robert A. Aldrich, and Violet Hawkinson; Concentration of Iodine in the Human Stomach and Other Tissues as Determined with Radioactive Iodine, Richard E. Goldsmith and Charles D. Stevens; Iron Metabolsim Studies in Normal Subjects and in Patients Having Blood Dyscrasias, Rex Huff, Thomas Hennessey, and John H. Lawrence; The Role of the Spleen in Radiation Injury, Leon O. Jacobson;

Studies in Protein Metabolism with the Aid of S^{35}-Labeled Methionine, Laurance W. Kinsell, Shelton Margen, Harold Tarver, Julie McB. Frantz, and Erin K. Flanagan; The Effect of Radiation on Total Coproporphyrin Excretion, Henry J. Koch, Jr., Timothy R. Talbot, Jr., and Mitchel Bernstein; Studies in Hemoglobin Formation with the Aid of the Isotope Technique, Irving M. London, David Shemin, and D. Rittenberg; An Abnormality in Nitrogen Metabolism in Cushing's Syndrome Altered by Testosterone Propionate: A Study Utilizing Glycine Tagged with Isotopic Nitrogen, N-15, William Parson; Study of a Human Cystinuric Fed Radioactive Methionine, Lester J. Reed, Doriano Cavallini, Fred Plum, Julian R. Rachele, and Vincent du Vigneaud; Some Biochemical Effects of Radiation, Samuel Schwartz; The Effect of the Iodide Ion on Thyroid Hormone Formation in Man, Malcom M. Stanley; Studies of Formation, Diffusion and Absorption of Constituents of Cerebrospinal Fluid in Man. I. Studies with Na^{24}, W. H. Sweet, B. Selverstone, A. Solomon, and L. Bakay; The Use of Emission Spectrography in the Study of Metabolism of Metals in the Blood in Man, Bert L. Vallee and John R. Loofbourow; The Iron Metabolism and Acid Fragility of Erythrocytes in Paroxysmal Nocturnal Hemoglobinuria, Philip F. Wagley and Margaret Adams; The Fate of Transfused Leukocytes, Austin S. Weisberger, Robert W. Heinle, John P. Storaasli, and Richard Hannah.

3389 Pyrimidine Nucleosides as Precursors of Pyrimidines in Polynucleotides. Einar Hammarsten, Peter Reichard, and E. Saluste. J. Biol. Chem. 183, 105-9 (1950) Mar.

Two rats each received subcutaneously a total of 25 mg of one of two nucleosides (cytidine or uridine, both labeled with N^{15} in the rings and the amino group) per 100 g of body weight, divided into six injections at 12 hourly intervals; the rats were killed 12 hr after the last injection, and the polynucleotides were isolated from the pooled internal organs. It was found that cytidine is a precursor in rats of PNA (ribose nucleic acid) and DNA (desoxyribose nucleic acid) pyrimidines. 15 references.

3390 Radioactive Isotopes in the Study of Peripheral Vascular Disease. III. Further Studies on the Circulation Index with an Evaluation of the Diagnostic and Therapeutic Value of Priscoline. Morris T. Friedell, Walter Indeck, and Fenton Schaffner. Arch. Internal Med. 85, 667-74(1950) Apr. (See also NSA 3-614)

The influence of Priscoline on the peripheral vascular circulation was estimated through the use of P^{32}. The radioisotope was first injected intravenously as a phosphate ion, and the counts per minute through the sole were determined and plotted semilogarithmically; the circulatory index was calculated. The index was altered by subjecting the patient to vasodilatation through the administration of a peripheral vasodilatator, Priscoline. When this agent was given intravenously, it was found that the reactions achieved enabled the investigators to classify certain types of vascular conditions; Priscoline was apparently more effective in conditions primarily due to interference with the blood supply than in severe associated causalgic states. Orally administrered Priscoline was found to be useful in the management of certain disorders of the peripheral vascular system.

BIOLOGY AND MEDICINE

3391 Radio Iodine Uptake in Humans. V. Absolute Determination of Radioiodine in the Thyroid. Henry J. Gomberg, William H. Beierwaltes, and Isadore Lampe. Proc. Soc. Exptl. Biol. Med. 73, 405-8(1950) Mar. (See also NSA 4-2250, 2251)

A counting technique is described for measuring the absolute radioiodine content of the thyroid in humans and dogs; a comparison is made with the results obtained by a direct measurement of thyroid radioiodine. The Geiger counter was located at some distance from the thyroid gland and was enclosed in a long lead tube (opening over the thyroid) so as to minimize background radiation. The statistical error is claimed to have been effectively reduced by this method. A maximum deviation of 20% was found on comparison of the radioactivity of the glands by β assays and by long-distance γ radiation counting; the majority of the counts agreed within 5%. Suggestions are made regarding improvement of in vivo measurements such as employed by this technique.

3392 Radioiron Excretion by the Skin and Kidney of Dogs. W. B. Stewart, R. T. Snowman, C. L. Yuile, and G. H. Whipple. Proc. Soc. Exptl. Biol. Med. 73, 473-5(1950) Mar.

Dogs were given Fe^{55} intravenously or orally and then were thoroughly scrubbed with a commercial detergent, and their urine was collected in order to determine the radioiron excretion by the kidney and the skin over a period of 1 day to 1 week. Little or no Fe^{55} could be washed from the skin and hair, indicating that no significant amounts are excreted through the skin over the period studied. There was considerable urinary excretion of the isotope.

3393 A Rapid Method for Determining Blood Volumes by the Use of P^{32}-Labeled Red Cells. Allen F. Reid and Marjorie K. Orr. J. Clin. Invest. 29, 313-16 (1950) Mar.

This paper presents a method of utilizing P^{32}-labeled red cells in a convenient procedure for determining accurate circulation blood volumes. A sample of 100 μc of P^{32} was injected into a 10-ml tube with 6 to 8 ml of the subject's blood and incubated until a sufficient amount of P^{32} was incorporated by the cells; a washed suspension of the cells was injected into the subject, and, after an interval of time allowing for uniform distribution, a sample was withdrawn; the radioactivities of the injected and withdrawn samples were measured, and the blood volume was calculated. Several errors and time-consuming procedures inherent in other methods using the P^{32} tracer are claimed to have been eliminated. 32 references.

3394 The Rates of Synthesis of Fatty Acids and Cholesterol in the Adult Rat Studied with the Aid of Labeled Acetic Acid. Alexander Pihl, Konrad Bloch, and H. S. Anker. J. Biol. Chem. 183, 441-50(1950) Apr.

The rate of synthesis of fatty acids and cholesterol in the adult rat has been determined with the aid of acetic acid labeled by C^{14}. The half-times for the saturated and unsaturated fatty acids were found to be about 1 and 2 days, respectively, in liver and 16 to 17 days and 19 to 20 days, respectively, in the carcass. The half-time of cholesterol was found to be 6 days in liver and 31 to 32 days in carcass.

BIOLOGY AND MEDICINE

Minimal values have been calculated for the utilization of acetic acid in the synthesis of cholesterol and of fatty acids in the adult rat. (auth)

3395 Relative Measurement in Vivo of Accumulation of Radioiodine by the Human Thyroid Gland: Comparison with Radioactivity in Peripheral Tissues. Thomas J. Luellen, F. Raymond Keating, Jr., Marvin M. D. Williams, Joseph Berkson, Marschelle H. Power, and William M. McConahey. J. Clin. Invest. 28, 207-16(1949) Mar.

In order to compare the kinetic behavior of radioiodine, I^{131}, in the thyroid of humans with observations in vivo on the peripheral tissue, the concentration of I^{131} in the blood, and the urinary excretion of I^{131}, experiments were devised for the observation and testing of 29 individuals; the subjects received tracer doses of I^{131} of 100 to 1,700 μc or therapeutic I^{131} doses of 2,500 μc in 100 μg of sodium iodide. The techniques are completely described; the results are graphed, discussed, and analyzed. The graphs are found to fit two curves of an exponential form with a negative rate constant in the exponent determined from the data for various thyroid conditions; this rate constant shows good agreement among all methods for its determination. The authors conclude that thyroid accumulation and I^{131} excretion are directly dependent quantities related by the rate constant, but that the excretion is dependent on other accumulation sites so that blood disappearance methods for determining thyroid accumulation are only applicable qualitatively.

3396 The Relative Rates of Metabolism of Neutral Fat and Phospholipids in Various Tissues of the Rat. Alexander Pihl and Konrad Bloch. J. Biol. Chem. 183, 431-9(1950) Apr.

The incorporation of isotopic carbon from C^{14}-acetate into the fatty acids of neutral fat and of phospholipids has been studied in isolated liver and in the intact rat. The results obtained show that in liver the rate of regeneration of neutral fat is faster than that of phospholipids. It is concluded that the phospholipids are not obligatory intermediates in the synthesis of triglycerides. In all other internal organs, including mesenterial fat, the isotope concentrations found in the phospholipids were markedly higher than in neutral fat. 19 references. (auth)

3397 Review of Recent Work on Nitrogen Metabolism. H. S. McKee. New Phytologist 48, 1-83(1949) Feb.

This is a complete review of the work done between 1937 and the date of publication on N metabolism, including some work on P metabolism where it pertains to the main topic. Mention is made of the use of N^{15} and other tracers in studies which are reported.

3398 Specific Activity of P^{32} in Cell Constituents of Rabbit Liver. Alfred Marshak and Fernando Calvet. J. Cellular Comp. Physiol. 34, 451-5(1949) Dec.

In order to test the hypothesis that the nucleus contains a nucleoprotein which behaves as a precursor to the ribonucleic acid (RNA) of the cytoplasm in nonproliferating tissue, rabbits were injected intravenously with Na_2HPO_4 containing P^{32} (1 mc/kg, 0.025 mg P^{31}/mc), and, at intervals after the injection, the animals were anesthetized and their livers

were perfused with cold Ringer solution. A portion of the tissue was taken for chemical fractionation, and the remainder of the tissue was used for the isolation of the nuclei by the citric acid technique; the phosphorus content was determined. It was found that the specific activity of the nuclear PNA (precursor of ribonucleic acid) was first much higher than that of the small cytoplasmic particles, but decreased with time, while that of the cytoplasmic particles increased until both reached about an equal value. This result is concluded to verify the previously stated hypothesis that the nuclear PNA functions as a precursor for the cytoplasmic PNA. Changes in the specific activity of the phospholipid, phosphoprotein, and acid-soluble fractions of the tissue and of the particulate cell components are described. A high specific activity of the phosphoprotein fraction was noted in the early intervals after injection, but the significance of this observation was not determined. (auth)

3399 Studies on the Utilization of Acetic Acid for the Biological Synthesis of Cholesterol. Henry N. Little and Konrad Bloch. J. Biol. Chem. 183, 33-46(1950) Mar.

The biological synthesis of cholesterol was investigated with the aid of acetic acid-1-C^{14}, acetic acid-2-C^{14}, and with acetic acid labeled by both C^{13} and C^{14}. The utilization of the 2 carbon atoms of acetic acid as a carbon source for the total molecule and for the cholesterol nucleus and side chain was determined. Methyl groups of acetic acid were identified as sources of carbon atoms 18, 19, 26, 27, and presumably 17 in cholesterol. Carbon atom 25 and probably carbon atom 10 are furnished by carboxyl groups of acetic acid. 17 references. (auth)

3400 Tissue Localization and Excretion Routes of Radioactive Dibromestrone. Gray H. Twombly, Leslie McClintock, and Morris Engelman. Am. J. Obstet. Gynecol. 56, 260-8(1948) Aug.

Details are given of the preparation of dibromestrone-Br^{82} from equilin and sodium bromide-Br^{82} with an activity of 0.6 to 3.26 mc/mg. The preparation was injected into 12 rabbits, 1 monkey, and 2 dogs in order to determine what organ concentrated the hormone and its route of excretion. Urine, fecal, tissue, and organ samples were taken at various times, reduced to a simple homogeneous solution, and the counts were determined. The results are tabulated, graphed, and discussed; the authors conclude that these observations strongly support the theory of an enterohepatic circulation of dibromestrone and, by implication, of other steroids as well.

3401 Transfusion of Leukocytes Labeled with Radioactive Phosphorus. Austin S. Weisberger, Robert W. Heinle, John P. Storaasli, and Richard Hannah. J. Clin. Invest. 29, 336-41(1950) Mar.

The fate of transfused leukocytes was studied by determining the distribution of radioactivity in various tissues of the body following the injection of leukocytes labeled with P^{32}. In rabbits sacrificed 30 min after the intravenous injection of radioactive leukocytes, most of the radioactivity was found in the lungs. Marked accumulation of radioactive leukocytes also occurred when the radioactive leukocytes were transfused via the aorta as well as the femoral and carotid arteries. This accumulation was correlated with the histological demonstration of engorgement of the intra-

alveolar septa of the lungs with leukocytes. In rabbits sacrificed 4 to 6 hr after the injection of radioactive leukocytes, the majority of the radioactivity was found in the spleen and lung on a per cent per gram basis; on a total organ basis, however, the liver contained the majority of the radioactivity. This shift of radioactivity away from the lungs is probably due, the authors claim, to destruction of the transfused leukocytes. Under the conditions of these experiments, the lungs play the major role in the prompt removal of transfused leukocytes from the peripheral blood; the liver and spleen also contribute, but the role of the peripheral capillaries is negligible. The authors conclude that the removal of the transfused white cells is more than a mere filtration of foreign bodies by the reticulo-endothelial system; this is indicated by the selective action of the lungs in removing cells transfused into the arterial as well as the venous system. (auth)

3402 Turnover of P^{32} in Different Types of Nuclei from Rabbit Liver. A. Marshak and Audrey Peck. Proc. Soc. Exptl. Biol. Med. 73, 479-80(1950) Mar.

Radioactive phosphorus, P^{32}, was administered intravenously to two rabbits as Na_2HPO_4, and 3 hr later the livers were perfused, and the nuclei were isolated and separated into two groups, the spherical hepatic-cell type and the nonspherical type consisting of fibroblast, reticulo-endothelial, endothelial, and polymorpholeukocyte nuclei. The specific activity of the spherical nuclei from the first animal was 34% greater than that of the nonspherical nuclei, while with the second animal the difference was 23%. The data indicated a higher rate of turnover of phosphorus in the spherical as compared with the nonspherical nuclei. It was previously shown that most of the P^{32} in liver nuclei was in nucleic acid and that it was released from the nucleus as nucleotide phosphorus. It is concluded that nucleic acid turnover in the nuclei of hepatic cells is more rapid than that of nuclei of other cells in the liver.

3403 The Use of Radio-Active Phosphorus (P^{32}) in the Diagnosis of Testicular Tumors: A Preliminary Report. Bernard Roswit, J. Sorrentino, and Rosalyn Yalow. J. Urol. 63, 724-8(1950) Apr.

A tracer dose of 300 to 500 μc of P^{32} was administered orally as H_3PO_4 at pH 7 to 6 patients with suspected malignancies of the testicles; the radioactivities of the normal testicle and the various areas of the abnormal one were measured 2, 4, and 24 hr after the isotope administration. The percentage differential counting rate was taken to be 100 times the difference between the counting rate of the normal and abnormal testicles divided by the counting rate of the normal testicle; a differential uptake of 25% was accepted as the upper limit for the normal testicle and benign lesions. Four of the 6 cases were correctly determined, as later proved by surgery; the two remaining cases were considered as failures, one giving a false negative and the other a false positive reading. Despite the preliminary nature of this investigation, it is suggested that radioactive phosphorus may have some value as an adjunct to present diagnostic methods. (auth)

CHEMISTRY

3404 Determination of Traces of Arsenic in Germanium by Radioactivation Analysis. A. A. Smales and L.

CHEMISTRY

O. Brown. Atomic Energy Research Establishment Report No. AERE-CR-439, Oct. 1949. 4p.

Consideration has been given to the problem of determining fractions of a part per million of arsenic in germanium by radioactivation analysis. It is concluded that slow-neutron activation of gram quantities of germanium, followed by a separation scheme as used previously, (Irvine, J. Phys. Chem. 46, 910(1942)) should make possible the detection of 10^{-8} g of arsenic and still require the chemical handling of only millicurie amounts of activity. Experimental work to test this possibility is suggested. (auth)

3405 The Gas Phase Reactions of Fluorine with Water. Part I. Reaction Times and Reaction Products in a Dynamic Fluorine-Water System. W. Davis, Jr., F. D. Rosen, R. H. Winget, Jr., and R. H. Wiswall, Jr. AECD-2827, Dec. 27, 1949, Decl. Apr. 20, 1950. 29p.

The reaction between fluorine gas and water vapor has been studied under the following conditions: room temperature, atmospheric pressure, fluorine in excess, and with nitrogen as a diluent. Under these conditions, the rate of formation of products that are stable in the presence of fluorine and water was found to be slow, and the reaction was quite incomplete in a 10-sec reaction period. The products of the reaction were found to be hydrogen fluoride, oxygen, ozone, hydrogen peroxide, and other unidentified oxidizing gases. (auth)

3406 Determination of Purity by Freezing Point Depression. Purity and Freezing Point of Hexadecafluoroheptane. V. E. Anderson and G. D. Oliver. K-555, Mar. 23, 1950. 11p.

The theory, apparatus, and experimental procedure for the determination of purity in mole% by the freezing-point depression method are described. The accuracy, precision, and limitations of the method are discussed. The purities and freezing points of a series of hexadecafluoroheptane samples are given. (auth)

3407 The Preparation and Reactions of Substituted Polychloro 1,1-Difluoroethanes. John T. Barr, Jr., J. Donald Gibson, and Robert H. Lafferty, Jr. K-590, Apr. 12, 1950. 23p.

A comparison was made of three methods of preparation of 1,1,1,2-tetrachloro-2, 2-difluoroethane: thermal chlorination over metallic chloride surfaces at 200 to 400°C, actinic chlorination at 125 to 200°C, and the replacement of fluorine in 1,1,2-trichloro-1,2,2-trifluoroethane by chlorine from aluminum chloride. The second method was found to be the most efficient of the three. A satisfactory procedure was developed for the preparation of 1,1-dichloro-2, 2-difluoroethylene by the dechlorination of 1,1,1,2-tetrachloro-2,2-difluoroethane. A study was made of the action of aluminum halides on the trichlorotrifluoroethanes. Halogen substitution, rearrangement, and disproportionation were found to occur. The activity of the halide increased with the atomic number of the halogen. Alkyl- and iodo-substituted chlorofluoroethanes were prepared by condensation reactions of chlorofluoroethylenes. 26 references. (auth)

3408 Machine Tool Hoods. N. G. Bohlin and S. S. Gold. ANL-4418, Mar. 1, 1950. 31p.

CHEMISTRY

Machine tool hoods for the protection of the operator against toxicity and radioactivity in the course of machining special materials and for the recovery of turnings, chips, etc., of these materials at the machining source, are pictured in actual photographs. Brief mention is made of the general design requirements and details.

3409 Design of a Vacuum Frame Hood. B. M Abraham and Nils Bohlin. ANL-4419, Mar. 6, 1950. 6p.

A vacuum frame hood is described, which was designed and built to provide adequate protection with a minimum of inconveniences for the wide variety of operations carried out in a vacuum line. This hood has been in successful operation for two years and has found wide acceptance throughout Argonne National Laboratory. Except for the bench-top cover and the decontamination tray, which are of stainless steel, the metal structural members are of aluminum; doors and ends are made of safety glass. Illumination for the hood is provided by eight 30-watt fluoroescent tubes. The whole assembly is of unit-type construction and, except for the utilities, which are brought in through the end or side panels, can be readily assembled or dismantled.

3410 The Chelation of Cerium as a Function of pH Using Thenoyltrifluoracetone. John F. Suttle. AECU-741, nd. 7p.

The properties necessary for a good chelating agent in the liquid-liquid extraction of a metal chelate include (1) formation of un-ionized chelate compounds with high solubility in a water-immiscible organic phase and low solubility in water, and (2) appreciable ionization and solubility of the chelating agent in the water phase. Thenoyltrifluoroacetone (TTA) has been applied to the extraction of cerium from benzene into water, and the dependence of chelation upon pH was determined. 11 references.

3411 Jet-Helix Extractor. L. Wainwright. AECD-2820, Nov. 28, 1949, Decl. Mar. 23, 1950. 10p.

A device, referred to as a "Jet-Helix" and which employs the centrifugal force developed by high-velocity flow through a helical channel to effect the first steps of separation between 2 immiscible solvents that have been thoroughly mixed by being jetted together, has been developed. The device consists of four basic sections: (1) jet mixing chambers which perform initial mixing, (2) contact tubes long enough and small enough to effect mass transfer during prolonged fine mixing due to high turbulence, (3) helical channels, which through centrifugal force cause a large percentage of phase separation, and (4) a staging box, where phase separation is completed and the stages interconnected. A multisection single-shaft pump contains the only rotating parts. Results with test models indicate that the multistage Jet-Helix Extractor is an easily controlled, effective device in compact form.

3412 Controlling Variables in Liquid-Liquid Extraction from Single Drops. William S. Farmer. ORNL-635, Apr. 20, 1950. 246p.

An investigation has been undertaken with the following objectives: (1) the selection of an extraction apparatus for which the hydrodynamics could be determined, (2) the choice of solvent-solute extraction systems whose chemical

behaviors are similar, (3) the correlation of the rate of extraction in terms of the physical and chemical variables mentioned above by successive variable elimination, and (4) evaluation of the results, to obtain extraction-rate coefficients suitable for design of spray and perforated plate columns.

Equilibrium distribution data and extraction rates are presented for water-solvent systems using acetic acid as a solute. Expressions are derived for correlating extraction rates for both the turbulent and transitional flow regime by means of hydrodynamic and diffusional concepts. The extraction rate for falling drops has been investigated for stripping acetic acid from the dispersed solvents—carbon tetrachloride, benzene, toluene, chloroform, methyl isobutyl ketone, and isopropyl ether—into a continuous water phase. It is possible to define the rate of extraction in the turbulent regime (Reynolds number 300 to 350) by means of an over-all mass transfer coefficient based on a fictive film in the dispersed phase. In the transitional regime of fall (Reynolds number 100 to 300) the rate of extraction obeys the diffusion law for spherical particles. No experimental data are given for the viscous range, since modifications would have had to be made in the apparatus to provide sufficient pressure to obtain drops of a small diameter. The relations involved in the viscous region would be expected to involve the diffusion equation, with the resistance of the continuous phase also becoming important. In investigating the hydrodynamics of the falling-drop column, drop deformations were observed in the turbulent-flow regime. The deformation increased with diameter, approaching a limiting value such that the major diameter was twice the minor. The velocity, as a function of drop diameter, passed through a maximum in the turbulent regime and then decreased in contrast to the behavior predicted by Newton's law for falling spheres. The effects of deformation on both the velocity and the rate of extraction have been taken into account in the correlation for the turbulent-flow regime by including the Weber capillary group. Large end effects were found to occur in the falling-drop column. Although no correlation was developed for this effect, it was found that the added extraction occurred during formation of the falling drop at the nozzle. The end effects are not only a function of the properties of the dispersed phase but also depend on the size of the nozzle, the size of the drop formed, and the time of drop formation. It is concluded that in order to correlate the rate of mass transfer in solvent-extraction systems in terms of film coefficients, a thorough knowledge of not only the hydrodynamics but also the chemistry and molecular diffusivity is needed. 30 references.

3413 Heterogeneity in Pyrimidine Nucleotides. Waldo E. Cohn. ORNL-658, Apr. 11, 1950. 5p.

Peaks have been obtained in the ion-exchange elution diagram of the pyrimidine nucleotides, cytidylic and uridylic acids. These results, together with small but significant difference in spectral properties, are taken as evidence of heterogeneity, if not true isomerism, in the pyrimidine nucleotides, thus raising the number of isolatable mononucleotides from yeast nucleic acid to eight.

3414 Preparation of Tritiated Cholesterol. David Kritchevsky, Max W. Biggs, and Norman K. Freeman. UCRL-644, Mar. 29, 1950. 5p.

In order to carry out metabolic studies in experimental arteriosclerosis it was desirable to obtain cholesterol labeled with a radioactive atom. Inasmuch as random labeling was sufficient for the purpose of our proposed experiments, preparation of tritiated cholesterol was undertaken. The method employed by Bloch and Rittenberg (J. Biol. Chem., 149, 505(1943)) for the introduction of deuterium into the cholesterol molecule was used with a few variations. Cholesterol (12.5 g) was shaken in a sealed tube with acetic acid (40 ml), reduced platinum oxide (1.25 g), and water (13 ml containing 300 mc of tritium). The reaction mixture was maintained at 125°C for 4 days, then the organic material was extracted, saponified with alcoholic KOH, and purified by chromatography on an alumina column. The cholesterol was eluted with benzene and benzene-ether, 1:1. The amount of cholesterol eluted initially amounted to 7 g (56%). The eluted material was purified through the dibromide, and several recrystallizations from acetone yielded a product, mp 148°, $[\alpha]_D^{25}$ to 39.3° (c, 0.4500 in $CHCl_3$). Two grams of the highly purified product was found to contain 0.48 mc of tritium per gram. The infrared spectra of the tritiated material and of a sample of purified cholesterol were compared and found to be identical. The amount of tritium incorporated in the molecule was too small to cause any changes in the infrared spectrum. (auth)

3415 Chemical Properties of Berkelium. Stanley C. Thompson and Glenn T. Seaborg. AECD-2821, Feb. 24, 1950, Decl. Mar. 23, 1950. 12p.

Radioactive Bk^{243} has been used as a tracer for investigation of the chemical properties of the new element, berkelium. This isotope has a half-life of 4.6 hr and decays by electron capture with about 0.1% branching decay by α-particle emission. Berkelium, curium, and americium were separated from each other by use of Dowex-50 ion-exchange resin and ammonium citrate as the eluting agent. A series of carrier precipitation experiments in which solutions containing Bk^{243} tracer were treated with oxidizing agents of various strengths indicated that the predominantly tripositive berkelium in aqueous solution can be oxidized to the (IV) oxidation state.

3416 The Heat of Formation of Thorium Tetrachloride. LeRoy Eyring and Edgar F. Westrum, Jr. AECD-2830, Mar. 8, 1950, Decl. Apr. 14, 1950. 10p.

The heats of solution of thorium metal and of thorium tetrachloride in 6M HCl have been measured. The addition of a very small concentration of sodium fluosilicate (Na_2SiF_6) was required to obtain quantitative solution of the metal. The heat of formation of $ThCl_4$(c) is calculated to be −284.5 kcal/mole at 25°C and is markedly lower than the value reported by Chauvenet (Ann. chim. et phys. (8)23, 425(1911)). (auth)

3417 Isotope Techniques for Determining the Uranium Content of Biological Materials. A. Rothstein, A. Frenkel, and C. Larrabee. AECD-2815, May 9, 1949. Decl. Apr. 6, 1950. 25p.

The isotope (radiometric) technique for uranium analysis, with modifications, can be applied to biological materials. The sensitivity depends on the degree of enrichment of the uranium sample with U^{233} or U^{234}. For natural uranium the limiting sensitivity is 5 μg. In the present work the limiting

sensitivity for a natural uranium sample enriched 1/200 with U^{233} was about 0.1 μg. This is not quite so sensitive as the photofluorometric method. Recoveries of standards containing 0.1 to 10 μg averaged 93%, with better recoveries associated with larger initial quantities of uranium. The limit on sensitivity of 0.1 μg is imposed by the α activity of the sample, rather than the electroplating technique. With pure U^{233}, the limit of sensitivity could be as low as 0.00035 μg, if such quantities could be quantitatively electroplated. No attempts were made in the present study to evaluate plating efficiencies for amounts of uranium below 0.1 μg. Standards, solutions containing little organic matter or salts, particularly calcium and phosphate (including some urines), can be directly plated without any prior treatment because the technique is insensitive to low concentrations of contaminants. This is a distinct advantage. Soft tissues, feces, and urines containing a high content of calcium, phosphate, and organic material must be ashed prior to plating, but usually require no isolation of the uranium. The recoveries are not so high as in the case of standards, but are satisfactory. Hard tissues, and in some cases, soft tissues, require both ashing and isolation. Coprecipitation with calcium phosphate, followed by extraction with ether-acetone mixtures has proved satisfactory. Total carcass recoveries from rats ranged from 75 to 105%, following administration of 94 to 200 μg of uranium. More than half of the dose was excreted in the urine. The excretion data by this technique were consistent with those obtained by other methods. The isotope technique requires considerable care on the part of the user if erratic data are to be avoided. 11 references. (auth)

3418 A Method for the Spectrographic Determination of Impurities of High Concentration in Uranium Oxides. L. E. Burkhart. AECD-2819, Jan. 15, 1948, Decl. Apr. 7, 1950. 12p.

An analytical method for determining impurities of high concentration in uranium oxide is described which is dependent on the differences of intensity of the uranium spectrum and the intensity of the spectrum of the impurities. This method employs a rotating sector to reduce the exposure in order to produce a spectrum of the principal lines of the elements present, thus rendering a considerable range of concentration determinable by spectrographic method. Standards are used with the plates, and results are interpreted by densitometering. The method provides an analysis generally accurate to ±10% for Si as high as 0.5%, Cr 0.5%, Al 1%, Mo 1%, Sn 0.5%, Ca 2%, V 0.5%, Fe 5%, Ni 0.5%, and Ti 1%. (auth)

3419 The Borides of Uranium and Thorium. Leo Brewer, Dwight L. Sawyer, D. H. Templeton, and Carol H. Dauben. AECD-2823, Feb. 14, 1950, Decl. Mar. 23, 1950. 9p.

The phases of the U-B and Th-B systems were investigated by means of x-ray powder-diffraction patterns of samples varying in composition from 25 at. % boron to 85 at. % boron. The samples were in the form of finely divided powders, and the x-ray diffraction patterns were taken on a 9-cm back-reflection camera with copper Kα radiation λ = 1.5418 A. The uranium-boron system has 3 intermediate phases, UB_2, UB_4, and UB_{12}. UB_{12} is not stable enough to be of use as a refractory. Both UB_2 and UB_4 are high melting, with UB_4 apparently being the higher melting. The U-UB_2 eutectic temperature is probably close to 1132°C. The UB_2-UB_4 eutectic temperature is well above 1565°C. The thorium-boron system has 2 intermediate phases, ThB_4 and ThB_6. ThB_6 is not stable enough to be of use as a refractory. ThB_4 probably has a melting point well above 2500°C. The Th-ThB_4 eutectic temperature is around 1550°C. ThO_2 apparently forms extensive solid solutions with thorium boride.

3420 The Rapid Fluorimetric Determination of Uranium in Low-grade Ores; A Preliminary Report. F. S. Grimaldi and Harry Levine. AECD-2824, Apr. 1948, Decl. Apr. 11, 1950. 13p.

A simple and very rapid fluorimetric procedure is described for the determination of uranium in low-grade shale and phosphate ores. The best working range is from 0.001 to about 0.04% U. The procedure employs batch extraction of uranyl nitrate by ethyl acetate, using aluminum nitrate as the salting agent, prior to the visual fluorimetric estimation. The procedure is especially designed to save reagents, only 9.5 g of aluminum nitrate and 10 ml of ethyl acetate being used for one analysis. The solution of the sample by means of a fusion with $NaOH$-$NaNO_3$ flux is rapid. After fusion, the sample is immediately extracted without removing silica and other hydrolytic precipitates. Aluminum nitrate very effectively precipitates fluoride and phosphate ions, thus eliminating steps required for their removal. (auth)

3421 A Direct Quantitative Fluorimetric Method for the Determination of Small Amounts of Uranium in the Field and Laboratory. Frank Grimaldi, F. N. Ward, and Ruth Kreher. AECD-2825, June 1949, Decl. Apr. 12, 1950. 13p.

This paper describes a quantitative fluorimetric method for the determination of small amounts of uranium (0.001 to 0.01%), useful for field and laboratory. A small sample is fused directly with a fluoride flux, and the fluorescence of the uranium melt is measured photometrically or visually. Niobium and other elements tested for interference with an excitation of 3600 A do not give any fluorescence in this procedure. Enhancement of the uranium fluorescence was observed in some samples. (auth)

3422 The Uranium-Cobalt System. W. K. Noyce and A. H. Daane. AECD-2826, Mar. 1, 1946, Decl. Apr. 18, 1950. 10p.

A phase diagram for the uranium-cobalt system has been constructed, based on thermal, microscopic, x-ray, and chemical data. The results indicate the existence of 3 compounds and 2 autectics, one of which shows a lowering of the melting point of uranium by approximately 400°C. 16 references. (auth)

3423 Spectrophotometric Studies of the Uranyl Citrate Complex. L. Feldman, W. F. Neuman, and J. R. Havill. AECD-2829, Aug. 25, 1949, Decl. Apr. 14, 1950. 21p.

Spectrophotometric studies of the uranyl citrate complex in acid and in basic solutions have been made. The stability of the complex in acid was confirmed, and its stability in

CHEMISTRY

basic solution was demonstrated. The absorption spectra of uranyl citrate and of uranyl chloride were obtained for the wavelength region 320 mμ to 440 mμ, and the effect of pH on the absorption by the complex was determined from pH 2 to 12 and for uranyl chloride from pH 3 to 6.5. The existence of the UO_2OH^+ from pH 4 to 4.7 has been confirmed. The stoichiometric ratio of uranium to citrate in the complex is unity from pH 3 to 4.5 and probably has a value greater than unity in neutral and basic solution. The dissociation constant of the complex was redetermined spectrophotometrically over the pH range 3.0 to 3.7; and the value obtained was 0.046 ± 0.009. The complex is only slightly dissociated at about pH 7. (auth)

3424 Fire Protection Precautions for Handling Uranium Turnings, Chips, Borings, Sawdust, and Powder. Edward J. Kehoe, Francis L. Brannigan, and Merrill Eisenbud. NYOO-1505, Mar. 1, 1950. 10p.

This report discusses the fire properties of uranium scrap with emphasis on its pyrophoricity. Safe procedures for storage, laboratory handling, disposal, and shipment are suggested. Existing Interstate Commerce Commission rules for shipment on common carrier are reviewed. The effect of various extinguishing agents on burning uranium scrap is described. (auth)

3425 Determination of Uranium in the Presence of Cerium (III), Thallium (I), Silver, Lead, Copper, Mercury (II), and Potassium Ferricyanide by Means of Isatin β Oxime. V. Hovorka and Z. Holzbecher. Collection Czechslov. Chem. Communs. 14, 40-58(1949)(in French).

The usual method of detecting U with isatin β oxime is applicable in the presence of Ce(III) or Tl(I). $Na_2S_2O_3$ is used to prevent precipitation of Ag, Pb, or Cu if present. To prevent precipitation of Hg(II) if present, excess Cl^- is used to form $HgCl_4^{-2}$. The separation of Fe(II) from U cannot be carried out by complexing the Fe as cyanide and oxidizing to $Fe(CN)_6^{-3}$, since a blue compound is absorbed by the preparation of uranyl isatoxime. (auth)

3426 The Oxides of Uranium Resulting from the Decomposition of Uranyl Oxalate. André Boullé, Robert Jary, and Marthe Dominé-Bergès. Compt. rend. 230, 300-2(1950) Jan. 16 (in French).

Experiments investigating the decomposition of uranyl oxalate with and without vacuum, the decomposition of uranyl oxalate by reduction, and the reduction of UO_3 with CO are discussed. The x-ray spectra of the resulting uranium oxides are compared, and an explanation of the mechanism of the decomposition of uranium oxalate is attempted.

3427 Superconductivity of Uranium. B. B. Goodman and D. Shoenberg. Nature 165, 441-2(1950) Mar. 18 (Letter to the editor).

The authors report that various samples of uranium were observed to become superconductors at temperatures ranging from 0.75 to 1.3°K, thus corroborating data previously reported by Justi (Physik. Z. 43, 207(1942)). The temperature of the transition appears to depend on the purity of the sample. The recent results of Heer and Daunt (Phys. Rev. 76, 715(1949)) indicate a similar situation for titanium. In the course of the experiments it was noted that large magnetic fields (of the order of 2,000 gauss/°K below the transition temperature) were required to destroy the superconductivity of the samples. It is probable that these high fields are not true thermodynamic critical fields, but are of the same nature as the apparent high critical fields of impure superconductors.

ENGINEERING

3428 Investigation of Stack Gas Filtering Requirements and Development of Suitable Filters; Report No. 8. Arthur D. Little, Inc. Report No. ALI-23, Feb. 28, 1950. 38p.

The present status of the work for the period September 1 to December 31, 1949, is summarized. A paper filter design has been developed, and performance characteristics have been determined. Facilities have been set up for producing full-size filters in pilot scale production. Samples of these filters have been provided to the various AEC sites for operating tests and for general evaluation. Manufacturing methods are being worked out with the intention that the filters in a variety of sizes will be produced by a commercial manufacturer. It should be understood that this kind of filter comes closer to being an absolute filter than any other type of air cleaning device now produced commercially. It is regularly observed that less than 0.02% of dust in the size range of 0.2 to 1.0μ is passed by these filters when new. Filtration very rapidly improves still further with use, and the improved efficiency remains up to the point where the dust load becomes so excessive that the units must be replaced. Much laboratory work has been done to evaluate both the filter medium and finished filter units. The primary dust load in an atomic energy installation is the dirt naturally found in the atmosphere. Therefore the tests have been carried on with particular emphasis on performance against atmospheric air-borne dust. The high-speed jet impactor was adopted as the test instrument and has proved itself satisfactory. Special precautions and techniques were found necessary when using the impactor to determine very low dust contents in filtered air. A special discussion of this subject is given. Filter media other than the especially developed paper have been studied, particularly glass fiber mats; and their performance characteristics have been observed. (auth)

3429 Heat Transfer by Natural Convection from Horizontal Cylinders to Liquid Metals: Second Quarterly Progress Report for October 1, 1949, to December 31, 1949. Seymour C. Hyman and Charles F. Bonilla. NYO-558, Dec. 31, 1949. 12p.

Data have been obtained with a new thermocouple surface for water, toluene, and Dow-Corning Silicone fluid type DC-200. In their lower range these data are in general agreement with the published correlation. The occurrence of turbulence was observed by its flow patterns to coincide with an upward break in the curves. An empirical correlation is proposed that includes all the existing data and superposes the breaks in the curves for the liquids tested. (auth)

ENGINEERING

3430 Film Heat Transfer Coefficients for Liquid Potassium-Sodium Alloys; Supplement No. 2. R. C. Werner and E. C. King. Mine Safety Appliances Company Preliminary Report No. 4, June 24, 1948. 59p. (AEC File No. NP-1412.)

A graphical method is presented whereby the individual film heat-transfer coefficients may be determined and correlated from the data obtained on a figure of eight type double pipe heat exchanger. The method overcomes the previous limitation of constant exponents in the Nusselts type of equation. This method with results is applied to two NaK alloy compositions of 44 and 78 wt.% K through a temperature range of 300 to 1200°F and a flow rate of 1.5 to 12 ft/sec velocity in the center stream giving film heat-transfer coefficients as high as 5500 Btu/(hr)(ft^2)(°F) at 800°F, which is approximately 2 times that of water at 120°F. The results are out of necessity reported in graphical form which indicates a trend similar to that reported by Martinelli (Trans. Am. Soc. Mech. Engrs. 69, 947(1947)) for the relationships between the Stanton number, the Reynolds number, and temperature for liquid metals. Results are also reported on the specific heat of NaK alloy from data collected on the main heater when used as a flow calorimeter. Values were obtained 10 to 30% lower than those reported by Bidwell (NRL Report No. C-3152, July 1947). (auth)

3431 Application of Nuclear Physics in the Steel Industry. Otto Rüdiger. Stahl u. Eisen 69, 671-5(1949)(in German).

The use of isotope tracers in metallurgy is reviewed with particular reference to the manufacture of steel. The analysis of the carbon content of steel by means of radioactive tracers is discussed, as well as the use of stable isotopes for H_2, N_2, and O_2 determinations. Neutron radiation is recommended for nondestructive testing of materials.

3432 Engineering Applications of Radioactive Materials. Philip R. Marvin. Non Destructive Testing, 26-34 (1949-50) Winter.

A discussion on the nuclear nature of radioactivity and fundamentals of application is given along with a survey of selected industrial applications. A few of the applications described are, liquid-level indicators, synthesis, thickness measurement, flaw detection, position indicator, static elimination, corrosion and friction studies, chemical and physical tracer applications, and ion source for gas discharge tubes.

3433 What Radioisotopes Can Mean to Industry. Charles Rosenblum. Nucleonics 6, 25-36(1950) Apr.

Forcasting ever-increasing use of radioisotopes by industry, the author reviews their application to problems in petroleum chemistry, metallurgy, polymerization, lubrication, corrosion, electrochemistry, agriculture, animal husbandry, and food processing. Analytical radiometric analysis is outlined. 53 references. (auth)

3434 Super Ion Gauge. F. H. Schmidt. AECD-2831, Nov. 1942, Decl. Apr. 25, 1950. 8p.

For investigation of actual vacuum-tank pressure and for information concerning the tank bake-out period, an ionization gauge was designed for mounting directly on a port in the tank. The gauge was designed to meet the following specific requirements: operation in a magnetic field of approximately 4000 gauss; impervious to the poisoning effects of the vapors in the tank; high pumping speed; filaments which could be easily changed without affecting the ion-gauge calibration; shielding from high electric fields; strong mechanical construction. Calibration data are given. Heavy electrical equipment, such as a traveling crane, was found to affect the emission of the gauge, thus making it unsuitable for leak hunting.

MINERALOGY, METALLURGY AND CERAMICS

3435 Fundamentals of Metal-Ceramic Mixtures at High Temperatures; Progress during Period February 1 to March 31, 1950. V. D. Frechette. New York State College of Ceramics Periodic Status Report No. 19, Mar. 31, 1950. 13p. (AEC File No. NP-1467.)

Oxidation Kinetics. The oxidation rate of metal-ceramic mixtures Co-Al_2O_3, Co-BeO, and Ni-Al_2O_3 increase with temperature in the range from 600 to 800°C. Oxide layer penetration was faster at 600°C than at 800°C because at the lower temperature the oxidation rate of the metal grains was slower and oxygen penetrated deep into the specimen before being bound by the metal. Penetration was greatly affected by the porosity of the specimen. Decrepitation of the specimens complicated the analysis of oxidation kinetics of Zr-Al_2O_3, Zr-BeO, and Be-BeO systems.

Survey of Binary Systems Including Be, Zr, Al with BeO, Al_2O_3, ZrO_2. Of the combinations of these oxides and metals in concentrations of 5, 10, 20, 40, and 80% by weight of metal, fired at 1000 and 1400°C for 3 hr, the following emerged as superior from the standpoint of durability and constancy of shape and size: 10% Al–90% BeO, 10% Al–90% Al_2O_3, 20% Be–80% BeO, 10% Be–90% Al_2O_3, 20% Be–80% ZrO_2, 20% Al–80% ZrO_2. Aluminum mixtures oxidized most slowly, zirconium mixtures decrepitated. The best ceramic member was that with the lowest thermal expansion, i.e., Al_2O_3 at 1400°C and ZrO_2 at 1000°C (the large volume change during inversion of ZrO_2 at 1000°C raises its mean thermal expansion over ranges from room temperatures above 1000°C).

Reaction Products Identification. X-ray diffraction verified the existence of metallic aluminum in specimens fired 72 hr at 1000°C or 3 hr at 1400°C. BeO.Al_2O_3 appeared in both Be-Al_2O_3 and Al-BeO systems fired 3 hr at 1400°C.

A section of the report is devoted to a discussion of apparatus and techniques used in connection with the studies described above.

3436 Thermal Conductivity of Bodies of High BeO Content. William A. Scholes. J. Am. Ceram. Soc. 33, 111-17 (1950) Apr. 1.

In an attempt to develop electrical porcelains having high thermal conductivity, bodies containing 80% BeO or more and falling within the ternary systems BeO-Al_2O_3-ThO_2 and BeO-Al_2O_3-ZrO_2 were investigated. The conductivities of all the ternary bodies fall within the range normally assigned to the metals, the values varying from 0.417 calorie/sec/cm^2/°C/cm at 53°C for 100% BeO to 0.199 at 147°C for 90% BeO, 5% Al_2O_3, and 5% ZrO_2. The addition of small amounts of MgO (4,8, and 15%) to these bodies (a) lowered the maturing temperature, (b) increased the firing shrinkage, and (c) decreased the thermal conductivity. The crystalline phases present after firing were identified through the use of x-rays

in an attempt to correlate final body composition and thermal conductivity. In all the bodies, BeO was the predominant phase with ThO_2 in one case and ZrO_2 in either the monoclinic or cubic form in the other case following in the order of decreasing relative peak intensity. The addition of MgO to either system materially affected the final crystalline phases present in the matured specimens. A description of the apparatus and procedure used to measure thermal conductivity is included. (auth)

3437 On the Ratio of Thorium Emanation to Radium Emanation in the Hydrosphere. Kazuo Kuroda and Yuji Yokoyama. Bull. Chem. Soc. Japan 22, No. 1, 34-42(1949).

The radioactivity of hot springs and mineral springs, in Japan, was investigated. Ionization measurements were made on water samples at the spring orifices and in the air directly above. Decay products of Tn [Rn^{220}] and $Rn^{[222]}$ were collected on negatively charged wires and also measured. The highest Tn content measured was about 6.8 $\times 10^{-8}$ Curie/liter. Tn was found to be widely distributed although the ratio Tn/Rn varied widely among the sources.

3438 On the Ratio of Thorium X to Radium in the Hydrosphere. Kazuo Kuroda and Yuji Yokoyama. Bull. Chem. Soc. Japan 22, No. 1, 43-5(1949).

The activities of ThX [Ra^{224}] and $Ra^{[226]}$, precipitated from waters of various springs in Japan, were compared. The ThX activity ranged from about 10^{-12} to 10^{-10} curie/liter and the ratio of activities ThX/Ra from less than 1 to more than 7.

3439 Radioactive Occurrences in the Kenora Area. E. O. Chisholm. Prelim. Report of Ontario Dept. of Mines (1950) Jan.

Disseminated radioactive material has been located by means of the Geiger counter in granitic rocks at 13 points within a radius of 40 miles from Kenora. With one exception the occurrences bear a remarkable similarity. They consist of submicroscopic grains of radioactive material as a constituent part of narrow pegmatitic stringers and dikes; they have a large amount of black biotite associated with them; they have a small amount of molybdenite flakes in the pegmatite; they show a lemon-yellow radioactive stain in the jointing-planes of the host rock; and they have radioactive equivalent assays less than 0.5% U_3O_8. Descriptions of the individual locations are given. It is believed that pitchblende vein material might be found in the area should the right geological conditions occur. (auth)

3440 The Radioactivity of Sediments. IV. Radioactivity and Petroleum. E. N. Tiratsoo. Petroleum 12, 313-15(1949) Dec. (See also NSA 3-338, 3-1105, and 4-2321.)

Previous workers have reported unusually high radon activities in crude oils and in oilfield waters (Bohn, J. Franklin Inst. 210, 461(1930); Bern, Kali 30, 41(1936)). Activity measurements were made on crude oil samples from Germany, Holland, Iraq, and Trinidad. Alpha-ray activities were found which indicated high radon concentrations, but no γ radiation was detected. These results tend to confirm previous reports, and to indicate that radon is absorbed by crude oil from the surrounding rocks. No radioactivity was detected in the oilfield waters. However,

MINERALOGY, METALLURGY AND CERAMICS

high activities were noted in several samples of oil shales. The activities of the oil shale and crude oil samples are tabulated. The author considers the possible influence of this radioactivity on the formation of oil deposits.

3441 The Thermal Expansion Characteristics of Beryllium. R. M. Treco. MIT-1043, Mar. 24, 1950. 28p.

A study has been made of the thermal expansion characteristics of vacuum-cast beryllium. Linear expansion coefficients for annealed and extruded beryllium are given for temperatures up to 1000°C. Results of expansion measurements on a single crystal of beryllium are discussed in relation to preferred orientation. The volume coefficient of expansion in the range 0 to 50°C has been calculated. (auth)

3442 Acid Corrosion Resistance of Tantalum, Columbium, Zirconium, and Titanium. Donald F. Taylor. Ind. Eng. Chem. 42, 639(1950) Apr.

Tantalum, columbium, zirconium, and titanium were tested in a number of reagents, under identical conditions of solvent action, to determine their acid corrosion resistance. Corrosion rates show tantalum to be completely resistant to all solutions tested; columbium had a high resistance against all these solutions except hot concentrated hydrochloric and sulfuric acids; zirconium and titanium were the least resistant of the four metals.

3443 Continuous Method of Producing Ductile Titanium. P. J. Maddex and L. W. Eastwood. J. Metals 188, 634-40(1950) Apr.

A continuous method of producing titanium has been proposed, and the feasibility of this process has been fairly well demonstrated. The method involves the continuous production of titanium or titanium-alloy ingots, employing magnesium and titanium tetrachloride as the raw materials. Actually, the continuous production of titanium or titanium-alloy ingots involves two steps carried out in a single integrated unit as follows: (1) Liquid magnesium is added continuously to a titanium tetrachloride atmosphere in the reduction chamber where these two reactants unite to form titanium and magnesium chloride at a temperature preferably about 1400 to 1600°F. This reaction product, if there is no residual magnesium, consists of about 89% liquid magnesium chloride and 11% solid titanium particles by volume. The reaction product probably would not be accumulated in the reaction chamber but would be permitted to run continuously from the bottom directly into an arc furnace where the second step is carried out. (2) In the arc furnace, the titanium is melted, and the magnesium chloride and unreacted magnesium are volatilized, condensed, and removed from the furnace chamber while a continuously formed titanium ingot is withdrawn from the bottom of the furnace. (auth)

3444 Electrolytic Polishing of Titanium. D. A. Sutcliffe, J. I. M. Forsyth, and J. A. Reynolds. Metallurgia 41, 283-4(1950) Mar.

Titanium may be satisfactorily polished electrolytically by making it the anode of a cell containing a mixture of acetic and and perchloric acids, using a titanium plate cathode and a current density of 30 to 40 amp/dm^2. A feature of the method is the short time required to obtain a scratch-free surface.

Prior to electrolytic polishing, the specimen is prepared by grinding in the usual way to 000 grade emery. The etchant used is a mixture of 2.5% nitric acid, 2.5% hydrochloric acid, and 95% water. Six photomicrographs are included.

3445 Electron Microscope and Diffraction Study of Metal Crystal Textures by Means of Thin Sections. R. D. Heidenreich. Bell Telephone System Technical Publications, Monograph 1702, 1-18(1949).

Bethe's dynamical theory of electron diffraction in crystals is developed, using the approximation of nearly free electrons and Brillouin zones. The use of Brillouin zones in describing electron diffraction phenomena proves to be illuminating since the energy discontinuity at a zone boundary is a fundamental quantity determining the existence of a Bragg reflection. The perturbation of the energy levels at a corner of a Brillouin zone is briefly discussed, and the manner in which forbidden reflections may arise at a corner is pointed out. It is concluded that the kinematic theory is inadequate for interpreting electron images of crystalline films. An electrolytic method for preparing thin metal sections for electron microscopy and diffraction is introduced, and its application to the structure of cold-worked aluminum and an aluminum-copper alloy is demonstrated. It is concluded that cold-worked aluminum initially consists of small, inhomogeneously strained and disoriented blocks about 200A in size. These blocks are not revealed by etching, but would contribute to line broadening in the conventional diffraction experiments. By means of a reorientation of the blocks through a nucleation and growth process, larger disoriented domains about 1 to 3μ in size found experimentally could be accounted for. It is suggested that such a nucleation and growth reorientation phenomenon is responsible for self-recovery in cold-worked metals.

3446 Potential Uses of Titanium Metal. O. C. Ralston and F. J. Cservenyak. Ind. Eng. Chem. 42, 214-18 (1950) Feb.

Uses of titanium as disclosed by the literature are cited and its usefulness to Army, Navy, and Air Force applications is discussed. The present high cost of producing the titanium metal will limit its field to specific applications.

3447 Quarternary Alloys of Titanium. C. M. Craighead, O. W. Simmons, and L. W. Eastwood. J. Metals 188, 539-52(1950) Mar.

Eighty-four quaternary titanium-base alloys from the following systems were investigated: (1) titanium-chromium-carbon-nitrogen; (2) titanium-chromium-carbon, with copper, vanadium, molybdenum, manganese, iron, or nickel; (3) titanium-chromium-nitrogen with vanadium, molybdenum, or nickel. The tensile properties, minimum bend radii, hardnesses, response to heat-treatment and aging treatment, and phase relationships of these alloys are reported. (auth)

3448 The Determination of Thorium in High Grade and Low Grade Ores. F. S. Grimaldi and Charlotte A. Marsh. AECD-2818, Sept. 1947, Decl. Apr. 7, 1950. 17p.

A gravimetric procedure is described for the determination of thorium in monazite ores, which is applicable to other ores of a wide range of composition. It is successful for

MINERALOGY, METALLURGY AND CERAMICS

both high and low (down to 0.04% ThO_2) grade ores. Thorium is separated from calcium, magnesium, and the bulk of the rare earths by double precipitation with ammonia, then from such elements as zirconium, titanium, and niobium by precipitation as fluoride, and from the remaining rare earths by peroxynitrate precipitation. Zirconium and sulfate interfere with the peroxynitrate precipitation. Conditions have been found that successfully overcome these interferences. (auth)

3449 Concentration and Sizing Tests with the Dutch State Cone. Edward S. Frohling. M.I.T. Mineral Engineering Laboratory Topical Report No. MITG-206, Dec. 20, 1948. 35p.

This report covers work performed from February to June 1948. Tests were run, using Driessen's Dutch State Cone as a classifier of quartz and as a concentrator of a synthetic ore made up of quartz and ferro-silicon. A theoretical treatment of the action of solids in the cone is proposed. The tests show that the cone can act as a classifier in the fine size range, but that, under the conditions tested, it will not operate well as a concentrator for fine heavy minerals. 10 references. (auth)

3450 Final Technical Report. L. G. Bassett, S. E. Wiberley, and J. U. Shepardson. NYOO-98, Dec. 12, 1949. 9p.

In the chemical analyses of a standard sample of high-grade uranium ore, deviations were obtained by four different laboratories: National Bureau of Standards; Lucius Pitkin, Inc.; Ledoux and Co; and Mallinckrodt Chemical Works. Results are presented for a comparison of the established analytical methods for U_3O_8 used by the above laboratories. A gravimetric procedure involving an extraction method for uranium was also used on the same ore sample. A preliminary investigation of a new rapid titrimeteric procedure involving mercury cathode electrolysis as a means of eliminating interfering elements is reported.

3451 Studies of Uranium Minerals. I. Parsonite and Randite. Clifford Frondel. Am. Mineral. 35, 245-50(1950) Mar.-Apr.

Parsonite, $Pb_2(UO_2)(PO_4)_2{\cdot}2H_2O$, is described from the Ruggles pegmatite, New Hampshire, and from Wölsendorf, Bavaria. The New Hampshire material occurs as crusts of microscopic monoclinic crystals. Analysis gave: PbO 47.43, UO_3 34.68, P_2O_5 14.46, H_2O 3.43; total 100.00 after deduction of 5.64% quartz. Parsonite also occurs at Wölsendorf as microscopic yellow crystals identical in habit with the Belgian Congo and New Hampshire material. Randite is claimed to be a mixture consisting principally of calcite and β uranotile with some tyuyamunite and not carbonate of calcium and uranium as originally described from Philadelphia, Pennsylvania, by Koenig in 1878. (auth)

3452 Studies of Uranium Minerals. II. Liebigite and Uranothallite. Howard T. Evans, Jr., and Clifford Frondel. Am. Mineral. 35, 251-4(1950) Mar.-Apr.

Liebigite, $Ca_2U(CO_3)_4{\cdot}10H_2O$, from Joachimsthal, Bohemia, has a_0 16.71 A, b_0 17.55, c_0 13.79; $a_0:b_0:c_0$ = 0.952:1:00.786. The x-ray powder data, morphological data, and new measurements of the optical constants are tabulated. Uranothallite is shown to be identical with liebigite. A new occurrence

MINERALOGY, METALLURGY AND CERAMICS

of liebigite at Wheal Basset, Redruth, Cornwall, England, is noted and the occurrence at Schneeberg, Saxony, is verified. (auth)

3453 Radiotracer Studies on the Interaction of Dithiophosphate with Galena. G. L. Simard, J. Chupak and D. J. Salley. Min. Eng. 187, 359-64(1950) Mar.

Radiotracers were demonstrated to be of considerable value in the study of a typical mineral-collector system, dithiophosphate-galena. Since they provide a rapid and sensitive analytical method, they are especially applicable to the conditions of flotation. Measurements were made of the rate of uptake, the isotherms, the desorption, and the exchange of dithiophosphate on both ground mineral and single crystals. It was concluded that no single mechanism could account for the observed over-all interaction. The process was complex because of the heterogenous nature of the galena surface. The interaction was not one of physical adsorption, but appeared to have characteristics of both chemisorption and surface chemical reaction. Flotation was achieved at relatively low concentrations of agent and at relatively small amounts sorbed. The process was quite irreversible.

PHYSICS

3454 The Aluminum-Aluminum Oxide System at High Temperatures. Leo Brewer and Alan W. Searcy. UCRL-552, Aug. 31, 1949. 42p.

The vapor pressures for aluminum and for aluminum oxide (Al_2O_3) have been determined by effusion experiments similar to those previously employed with graphite (Brewer et al, J. Chem. Phys. 16, 797(1948)). Vaporization from Al-Al_2O_3 mixtures has also been investigated. The existence of 2 gaseous sub-oxides of aluminum is demonstrated; these are assumed to be AlO and Al_2O. The heats of formation for these oxides are as follows: $Al(g) + O(g) = AlO(g), \Delta H_{298} = -138$ kcal; $2Al(g) + O(g) = Al_2O(g), \Delta H_{298} = -248$ kcal. 24 references.

3455 Physics Division Quarterly Report; November and December 1949 and January 1950. UCRL-627, Feb. 7, 1950. 80p.

Under general physics research the following topics are reported: cloud chamber program; film program; development of electronic equipment for high energy pair spectrometer; measurements of total cross sections; particle spectrometer; film track study of the external neutron field; high energy photons; proton elastic scattering; p-p scattering at 340 mev; measurement of the cyclotron duty cycle; short life polonium isomers; scintillation counter development; production cross sections for positive and negative π^- mesons by 345-mev protons on carbon at 90° to the beam; capture of negative π mesons in hydrogen; proton-proton scattering near 30 mev; production of mesons by proton bombardment of liquid hydrogen; synchrotron studies; theoretical physics.

Accelerator operation and development are reported under the following topics: 184-inch cyclotron; overhaul of the the 60-inch cyclotron; synchrotron; linear accelerator and van de Graaff machines; bevatron development.

3456 Summary of the Research Progress Meeting of February 23, 1950. Henry P. Kramer. UCRL-628, Mar. 16, 1950. 17p.

PHYSICS

Research on the following topics is discussed: investigation of showers produced from synchrotron γ rays; synchrotron experiments with nuclear plates, including a hydrogen target experiment, a carbon target experiment, and stars from photons; theoretical interpretations of photomeson production.

3457 Lambda-Temperatures of Solutions of He^3 in He^4. Olive G. Engel and O. K. Rice. Phys. Rev. 78, 55-7(1950) Apr. 1.

An expression for the effect of He^3 on the λ point of He^4 is developed from thermodynamic principles. Use is made of the idea that normal He^3 and superfluid He^4 are in equilibrium with each other and that the λ temperature is the temperature at which superfluid first appears. This expression contains the difference in enthalpy of normal fluid and superfluid. The λ points of mixtures containing large amounts of He^3 are discussed on the basis of various assumptions regarding this difference in enthalpy as a function of temperature. (auth)

3458 Measurements of the Influence on the Fountain Effect of He^3 Dissolved in He^4. K. W. Taconis, J. J. M. Beenakker, and Z. Dokoupil. Phys. Rev. 78, 171(1950) Apr. 15 (Letter to the editor).

In pure He^4 a fountain pressure occurs between two vessels when a temperature difference is established, the contact being by way of the helium film. The authors find that when using an apparatus similar to that used by Daunt (Phys. Rev. 73, 638(1948)) the normal fountain effect can be compensated by dissolving He^3 in the colder vessel. A preliminary investigation at 1.38°K showed that the reduction of the fountain pressure is proportional to the osmotic pressure for a dilute He^3 solution according to Van't Hoff's law. The same reduction may be expected to a first approximation from the two-fluid model, if it is assumed that the He^3 dissolves in the normal fluid only.

3459 The Evolution of Sun Involving Corpuscular Radiation. A. G. Masevich. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 13, 621-30(1949)(in Russian).

A general outline is given of a theory of stellar evolution proposed by Fesenko (Astron. Zhur. 26, 67(1949)) and worked out by the author in some of its aspects (ibid., 211(1949)). The following are its principal assumptions: (1) The recent nuclear-reaction schemes account well for the main transmutations of matter in cosmic objects; in stars of the type of the sun the transformation H — He is the only important one; it takes place mainly in the inner core of the star (about 0.1 of the star's diameter), characterized by the presence of convective movements. (2) The principal feature of the evolution is a corpuscular radiation, a perpetual loss of mass, rapid in youth, and very slow in later life: Fesenko assumed that the rate of the loss is proportional to the luminosity ($dM/dt = -kL$); with this hypothesis a stand is taken which is entirely different from that of Bethe who assumed a constant mass: this latter hypothesis leads to the known conclusion ascribing equal age (two billion years) to all stars of the main sequence; for Fesenko, on the contrary, there are stars of all ages in the main sequence, and it is in this statistical domain that they perform the most significant part of their evolution. On the basis of these assumptions, two differential equations of the equilibrium

of the stellar model are written, tying together the star's parameters; mass, radius, luminosity, and molecular weight; it is shown that the latter, in the case of the sun, is uniquely determined, if the H and He contents alone are known. However, owing to mass losses, the equilibrium is only apparent. Nevertheless, the equations can be used as momentary pictures of states, so that, using the known velocity value of the H – He reaction, all the foregoing parameters can be determined for any moment in the past at which the He/H ratio had a given value, back to that moment when it was equal to 0. The mass-time curve, thus obtained, shows that the rapid loss of mass in the sun has ceased about 2.5 to 3 billion years ago; since then the loss is very small; these results coincide with the geological evidence. There are reasons to believe that in the remote future the sun, owing to a degeneracy of the inner core, will glide off the main sequence.

3460 Proton-Proton Reactions in Red Dwarf Stars. Lawrence H. Aller. Astrophys. J. 111, 173-8, (1950) Jan.

The relative roles of the carbon cycle and of proton-proton reactions in red dwarf stars are compared. It is shown that in the cooler stars there is a very good chance that proton-proton reactions may play a role comparable with that of the carbon cycle or may even supply the total energy output of the star.

3461 Bibliography of Meson Research. Dora F. Sherman. UCRL-487, Mar. 10, 1950. 87p.

In this report are briefly abstracted all papers in the literature which are reviewed in "Physics Abstracts" for the years 1946 through 1949, on the production and properties of mesons, on nuclear stars in photographic emulsions, and on photographic emulsion techniques for the study of mesons. Cosmic ray research and meson theory have been included if they gave information concerning properties of mesons which the film study group might measure. Theoretical papers were included if they suggested experiments which would choose decisively between conflicting meson theories.

3462 The Distribution of the Positive-Negative Ratio for Mesons. Bayard Rankin. UCRL-549, Dec. 14, 1949. 11p.

Positive and negative mesons produced in a common target in the cyclotron are received in two photographic plates. In the magnetic field of the cyclotron, negatives are deflected to one plate, positives to the other. The mesons must pass through an absorber before entering the plates in order to be observable. The experimental design is that used for determining the positive-negative ratio for mesons. Observations are made on the plates by counting the number of mesons and taking account of the area covered. The problem involved here is (1) to estimate the true ratio of positive to negative mesons produced in nuclear reactions under given conditions, and (2) to find the statistical error in the estimate. This problem is solved by finding the maximum likelihood estimate of the ratio and by deriving the distribution of a variable related to the ratio of two Poissons. In the second part of the discussion the content of a new theorem is encompassed and the theorem proved.

3463 Production of π^- Mesons in Proton-Proton Collisions. Vincent Peterson. UCRL-558, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Initial experiments on the production of π^- mesons in the bombardment of a liquid hydrogen target by 350-Mev protons will be reported. A preliminary value of the differential cross section at 30° (lab. system) obtained with photographic detectors, is in reasonable agreement with theory.

3464 γ Rays from Capture of Negative π Mesons in Hydrogen. Wolfgang K. H. Panofsky. UCRL-580, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

130-Mev γ rays produced be capture of negative π mesons in hydrogen have been observed. The internal proton beam of the 184-inch cyclotron strikes a thick carbon target which faces a pressure vessel containing H_2 at a pressure of 3000 psi at 78°K. Some of the mesons produced are absorbed in the hydrogen and the resultant γ ray is detected outside the cyclotron enclosure by a positron-electron pair spectrograph accepting pairs of total energy 130 ± 40 Mev. The observed counting rates are of the order of 50 cts/hr. The accuracy of the counting rate prediction is insufficient to determine whether π-μ decay competes with the observed γ-ray yield.

3465 A Technique for Measuring Meson Production Cross Sections in the Forward Direction. H. A. Wilcox, W. F. Cartwright, C. Richman, and M. N. Whitehead. UCRL-615, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

In a previous communication a method was described for measuring the positive and negative π meson production cross sections of various nuclei when bombarded by 345-Mev protons in the external beam of the synchro-cyclotron. The method was successfully applied to mesons produced at 90 deg to the beam in carbon and in lead. For observations in the extreme forward direction, however, the heavy proton background has made it necessary to extend this technique by introducing a magnetic field in the region about the target. Negative mesons are deflected in this field to one side and positive mesons and protons are deflected to the other. Curved channels in large shielding blocks are arranged so as to select roughly equimomenta particles which then enter and stop in absorber blocks containing embedded nuclear emulsions. A complete spatial separation is obtained between the protons and the positive mesons since the mesons penetrate much more deeply into these blocks than do the heavier protons having the same momenta. Preliminary results on the forward production from carbon and hydrogen will be presented.

3466 Production of π Mesons in Nucleon-Nucleon Collisions. Keith A. Brueckner. UCRL-630, Mar. 9, 1950. 11p.

Calculations are made of the differential cross sections for production of charged or neutral mesons in n-p and p-p collisions, for scalar meson theory, pseudoscalar meson theory with pseudoscalar and pseudovector coupling, and

vector meson theory with vector coupling. These calculations are made in the center-of-mass coordinate system for energies near threshold, and corrections of the order v^2/c^2 for the mesons or nucleons are neglected. The results are presented in graphical form. These results are subject to the large uncertainties of the weak coupling approximation applied to meson theory, but it is hoped that they are at least qualitatively correct.

3467 Are Mesons Elementary Particles? H. M. Moseley and Nathan Rosen. Phys. Rev. 78, 67(1950) Apr. 1. (Letter to the editor).

The authors have been investigating the possibility, suggested by Fermi and Yang (Phys. Rev. 76, 1739(1949)) that the meson is a composite particle consisting of a nucleon and an antinucleon. They find that the $^1S_0$ state of such a particle must be eliminated as a physical possibility because its energy tends to zero rather than to 2 mc^2 as the interaction goes to zero. On the other hand the $^3P_0$ state appears to give an acceptable solution. These results apply to the case of the vector interaction adopted by Fermi and Yang. For the tensor type of interaction it is found that the $^1S_0$ solutions exist for one sign of the interaction parameter and the $^3P_0$ solutions for the other. Since it would follow that not only a proton and an antineutron but also a proton and a neutron would form composite particles, it appears that this type of interaction must be discarded.

3468 Further Evidence for the Existence of τ Mesons. J. B. Harding. Phil. Mag. 41, 405-9(1950) Apr. (Correspondence).

The author reports an event observed by him in an Ilford G5 200μ emulsion, a facsimile drawing of which is shown. It is concluded from a detailed analysis, that this event is to be interpreted as the spontaneous decay of τ meson, i.e., of a praticle of mass approximately 1,000 times that of the electron.

3469 The Latitude and Longitude Effects in Cosmic Rays over the United States and Canada at 30,000 Feet. A. T. Biehl and H. V. Neher. Phys. Rev. 78, 172-3 (1950) Apr. 15 (Letter to the editor).

The authors investigated the change with geomagnetic latitude and longitude of the number of the ionizing particles at 310 g/cm^{-2} that could penetrate various thicknesses of absorber. A number of flights were made covering the latitude range from 40 to 64 deg geomagnetic north with counter telescopes and ionization chambers, the latter being both unshielded and shielded with 10 cm of lead. From the experimental results it is concluded: (1) there is a small increase both with counter telescopes and ionization chambers from 2.5 to 3% from latitude 50° to 64°N, which is approximately the same with or without a lead absorber; (2) in going south with latitude 50°N the number of ionizing particles measured along 80°W falls off more slowly than along longitude 115°W.

3470 On the Disintegration of Boron by Cosmic Rays. A. P. Zhdanov and K. I. Ermakova. Doklady Akad. Nauk S.S.S.R. 70, 211-14(1950)(in Russian).

The authors point out that the use of thick photographic emulsions for the study of nuclear disintegrations has been introduced by the Russian Mysovskiĭ (Z. Physik 44, 408 (1927)). The present paper describes an improvement of this method, which removes the uncertainty as to the nature of the atom that has undergone a disintegration. During the preparation of an emulsion, a suspension of an element, e.g., boron, is introduced, all the suspension grains being conspicuously larger than the other grains that will appear in the developed photographic emulsion; in this way a star, whose prongs emerge from a boron grain, will certainly represent a disintegration of a B atom. Photographs of several such stars, produced by cosmic rays, are given and discussed. One of them, exhibiting four prongs, is interpreted as $\pi^- + B^{10} \rightarrow H^1 + He^4 + \mu^+ + 5n$, a new reaction type, showing a capture of a slow negative particle and a liberation of a lighter positive meson.

3471 On the East-West Asymmetry Exhibited by Isolated Cosmic Ray Tracks in Sensitive Emulsions. Hassan Moucharafyeh, Max Morand, and Simone Rebaud. Compt. rend. 230, 834-6(1950) Feb. 27 (in French).

Morand (Compt. rend. 228, 1488(1949); ibid. 229, 40 (1949)) has recently reported an east-west asymmetry in the distribution of isolated cosmic ray tracks in plates exposed in the vicinity of the geomagnetic equator. The author has made a study of the origin of these isolated tracks, and concludes that only a small number are caused by μ mesons originating in the air. It is, therefore, impossible to attribute the asymmetry of the isolated tracks in plates to the asymmetry in the distribution of μ mesons in the upper atmospheres.

3472 On the Mass of the Cosmic Ray Particles. Étienne Bastin, Jean Becker, Paul Chanson, Eugène Nageotte, and Pierre Treille. Compt. rend. 230, 739-41(1950) Feb. 20 (in French).

This paper describes an experiment, carried out at an elevation of 3,650 m, designed to detect cosmic ray particles with masses intermediate between that of the meson and the proton. The experimental arrangement was similar to that described by previous authors (Lhéritier et al, Compt. rend. 225, 1304(1947)). The masses were calculated from the momenta of the particles, as measured in a cloud chamber, and the number of copper plates, placed below the chamber, necessary to stop the particles. The following results are reported: if particles of intermediate mass exist, they must have a mean life less than 10^{-9} sec so that they were not detected by the apparatus, or the flux of these particles was too low to detect. Particles with masses greater than the proton mass were found to be twice as numerous as previously reported. Two such particles with negative charges are difficult to explain. In a preliminary experiment, the authors obtained a mass spectrum similar to that reported by Alikhanian et al (Doklady Akad. Nauk S.S.S.R. 61, 35(1948)), but no conclusions can be drawn from this experiment because of the many sources of error.

3473 On the Ratio of Positive and Negative Photo-Mesons. Otto Halpern. Phys. Rev. 78, 69(1950) Apr. 1 (Letter to the editor).

Brueckner and Goldberger (Phys. Rev. 76, 1725(1949)) have recently published a theoretical calculation of the

PHYSICS

ratio of the numbers of positive and negative photomesons observed. The author's unpublished calculations lead to similar results with a characteristic difference illustrated by the following example: in treating the case of scalar coupling between mesons and nucleons the formula of Brueckner and Goldberger does not take into account the processes in which the spin of the proton changes when the incident quantum is absorbed. When these are included, it turns out that the threshold value of the cross section for the creation of photomesons is finite as far as the electromagnetic matrix elements are concerned and is independent of the sign of the mesons created.

3474 On the Sudden Increase in Cosmic-Ray Intensity on November 19, 1949. D. C. Rose. Phys. Rev. 78, 181-2(1950) Apr. 15 (Letter to the editor).

Continuous recording of cosmic-ray intensities by Geiger-Mueller counters is being carried on at Ottawa and at Resolute (latitude 74°,41'N, longitude 94°,55'W geomagnetic latitude 83 deg). An analysis is given of sudden increases in cosmic ray intensities at these stations on November 19 and November 29. The temporal correlation of these increases with those reported by Forbush et al (Bull. Am. Phys. Soc. 25, 15(1950)) is discussed.

3475 Production of π Mesons by High Energy Electrons. E. Strick and D. Ter Haar. Phys. Rev. 78, 68-9 (1950) Apr. 1 (Letter to the editor). (See also NSA 3-1239.)

The cross section for meson production by electrons of extremely high energy has been calculated by two different methods. First the authors used a straightforward third order perturbation treatment with a charged scalar meson field. They then obtained the same result by using the impact parameter method [the Weizsacker-Williams method (Z. Physik 88, 612(1934)]. It can be shown that recoil effects may be neglected in these calculations. The expression obtained for the cross section is valid for large values of the electron energy. An approximate expression is given for electron energies just over the threshold. For an electron energy of 300 Mev, the cross section turns out to be about 10^{-31} cm^2/nucleon. The expression given for the cross section is exactly the same as the cross section calculated for pseudoscalar fields (Sneddon and Touschek, Proc. Roy. Soc. (London) 199A, 352(1949). (See also NSA 3-1239.)

3476 The Semi-Diurnal Component of Cosmic Ray Intensity at Bandung (Java). H. R. Woltjer and Go Pok Oen. Physica 16, 122-32(1950) Feb.

Observations at Bandung (Java) of cosmic ray intensity by means of a Steinke ionization apparatus during 1939 and 1940 show a semidiurnal component in oposite phase to the semidiurnal component of the barometer. On closer inspection it may be interpreted as a superposition of a normal barometer effect (opposite phase) and a same phase component that can be explained as a result of the semidiurnal movement of the meson-producing layer in the atmosphere.

3477 A Demountable Tetrode Ionization Gauge. J. E. Johnston. Atomic Energy Research Establishment Report No. AERE-G/R-480, Jan. 1950. 9p.

PHYSICS

A demountable tetrode ionization gauge with a tungsten filament that can readily be replaced is described. The additional grid in the gauge provides a simple means of stabilizing the electron current. The measured value for the stabilization agrees with the value calculated from the measured current-voltage characteristics of the gauge and is comparable with the stabilization achieved using the more complex circuits needed to stabilize the emission in a triode ionization gauge. The disadvantage of the gauge is that due to the heat of the filament much gas comes from the vacuum seal and any nearby metal walls unless they are cooled. Tetrode gauges mounted on pinches inside glass envelopes are satisfactory from this point of view. (auth)

3478 Relay Microscope for Remote Observation at Magnifications up to 75 Diameters. A. H. Canada. General Electric General Engineering and Consulting Laboratory Report No. R50GL46, Feb. 27, 1950. 15p.

The operation and constructional features of a relay microscope are described which transfers an image by a 1 to 1 relay system 38 in. from the object and then uses conventional observation means to view the image. Useable magnifications of 75 diameters are obtainable with this design of relay system. Extension to longer relay distances or to better resolution is dependent on numerical aperture of the system. (auth)

3479 Survey of the Present State of Isotope Separation Methods. W. Groth. Z. Electrochem. Physik. Chem. 54, 5-12(1950)Jan. (in German).

The author discusses, in a nontechnical manner, the various techniques for isotope separation and their degrees of success. In addition to the electromagnetic, thermal diffusion, and porous barrier methods, he includes, among others, those based on the peculiar liquid properties of HeII, the selective absorption of light by certain isotopic molecules in photochemical reactions, the removal of the slower traveling particles from a molecular stream by a rotating diaphragm, the centrifuge principle, exchange reactions, and differential recombination after dissociation in a gaseous discharge. He concludes with some of the geologic processes effecting a natural separation of isotopes.

3480 Thermal Diffusion; A Bibliography. Atomic Energy Research Establishment Report No. AERE-Inf/Bib-59, Feb. 10, 1950. 32p.

This bibliography contains a comprehensive collection of references (322) to the process of thermal diffusion in fluids, its theory, its experimental investigation, and its application to the separation of isotopes. References to published literature have been obtained from Chemical Abstracts, Science Abstracts A, and Nuclear Science Abstracts. These sources have been searched from the beginning of publication to December, 1949. In addition, a number of references have been taken from "The Separation of Isotopes by Thermal Diffusion" by Jones and Furry (Revs. Modern Phys. 18, No. 2, 151-224(1946)Apr.).

3481 The Recording Mass Spectrometer. A Versatile Tool for Research and Quality Control. R. M. Ilfeld. Instrumentation. 4, 20-4(1950).

PHYSICS

This paper describes a direct recording mass spectrometer, produced by General Electric, with a high resolution and wide range. This instrument is normally sensitive to one part in 10,000 but a sensitivity of one part in 100,000 may be attained under special circumstances. A schematic diagram of the apparatus is presented and the operation of the spectrometer is explained. The author discusses the commercial and scientific applications of this instrument.

3482 Transforming Observed First Differences to Uncorrelated Variates. A. de la Garza and G. A. Garrett. K-583, Mar. 29, 1950. 11p.

In many applications of statistical methods, there is need for the study of the regression of differences between successive values of an observed variate on other observed variates. In such situations, statistical treatment of the data is complicated by the correlation between the adjoining differences due to common elements. A nonsingular linear transformation is derived for transforming first differences $y_i = x_i - x_{i+1}$, $i = 1,2, \ldots, n$, where the x_i are assumed to be uncorrelated observations of equal variance, into a set of n uncorrelated variates of equal variance. The transformation has a triangular matrix of the form $T = (T_{jk})$ where $t_{jk} = k/\sqrt{j(j+1)}$ for $k \leq j$ and $t_{jk} = 0$ for $k > j$. An application to linear regression is shown. The elements t_{jk} are presented in a table which may be used for any sample size up to 30. (auth)

3483 Very Fast Particle Resolution by Means of Crystal Radiation Counters and Pulsed Amplifiers. Louis F. Wouters. AECD-2816, Oct. 17, 1947, Decl. Apr. 3, 1950. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Many modern particle accelerators produce short well-spaced bursts of particles (80/sec, 30μ sec long, for example); direct coincidence counting experiments are presently limited to a resolution time of 10^{-7} sec. Silver chloride crystal counters appear to have collection times of 10^{-8} sec; similar amplifier rise times may be obtained by pulsed operation synchronous with accelerator output.

The transconductance of an amplifying tube being approximately proportional to the cube root of the plate current, a hundredfold increase over the rated plate current permits a fivefold reduction in rise time, provided there is sufficient emission. To realize such momentarily high currents, positive grid voltages are necessary; therefore, low-resistance coupling devices should be used. Gain stabilization by means of a high-frequency carrier may be desirable.

Measurements of transconductance of small commercial receiving tubes under pulsed conditions will be summarized. The merits of neutralized push-pull triode amplifiers will be discussed.

Such a high-speed amplifier will permit examination of charge collection in crystal counters; transit time experiments within the range of the primary particles should be possible.

3484 Palladium Film Fast Neutron Detector. B. R. Gossick. ORNL-650, Apr. 11, 1950. 12p. (See also NSA 4-1489.)

Detection is by the measure of resistance change of a "reduction" (or N-type) semiconductor, the reducing agent being nascent hydrogen from proton recoils. The resistor is a thin film of an oxide of palladium, which is not completely anhydrous. Conductivity of the film is due to a stoichiometric excess of metal palladium. Results of exposures to pile neutrons are reported. Preparation of the palladium-palladous oxide films is described.

3485 The Cadmium Sulfide X-ray Detector. Rudolf Frerichs. J. Applied Phys. 21, 312-17(1950) Apr.

The CdS x-ray detector is compared with the photomultiplier x-ray detector. Reduced to the same solid angle the sensitivity of the CdS x-ray detector is of the same order of magnitide as the sensitivity of the photomultiplier x-ray detector. As the internal amplification of the primarily released electron currents in CdS is of the order 10^3 to 10^4 compared with the amplification in the multiplier tube of $\frac{1}{2} \times 10^6$ the conversion process of x-ray quanta in slow electrons in CdS must be more efficient than the corresponding processes in the combination crystal phosphor screen photomultiplier. Calibration curves show a linear relation between photocurrent and intensity of x-rays at low irradiation levels. At high irradiation saturation effects occur. Oscilloscope curves of the response at 60 x-ray pulses/sec are given. At strong irradiation the photocurrent over a long time increases in a completely reversible way. X-ray intensities as low as 150 quanta cuK_α/sec are registered with a circuit employing a WL 759 trigger tube. (auth)

3486 The Contraction of Nuclear Emulsions. S. L. Martin. Australian J. Sci. Research 2A, 389-93 (1949) Sept.

A technique for measuring the fractional change in thickness which occurs when a nuclear emulsion is processed, is described. The method involves the registration in the emulsion of the tracks of α particles from a radiothorium source and this permanent record can be used to follow any subsequent thickness variations. Some observations on Ilford C2 emulsions, 50μ in thickness, have been made and these show considerable variations in thickness over a period of time. Tests indicated that some of the change is probably due to humidity variations. The application of this method to the monitoring of variations in k for emulsions, in which deuterons or other tracks have been registered, is described. (auth)

3487 Design of Vibrating Capacitor Electrometer. Harry Reese, Jr. Nucleonics 6, 41-5(1950) Mar.

It is pointed out that for the continuous monitoring and recording of radiation from radioactive areas it is necessary to have a sensitive electrometer with a very good stability, and that the vibrating capacitor electrometer is a satisfactory instrument for this purpose. This article describes a particular type of such an electrometer and reviews the design considerations investigated in making the instrument as rugged and stable as possible.

3488 Determination of the Energy of High-Energy γ-Rays by the Photographic Method. D. T. King. Nature 165, 526-7(1950) Apr.(Letter to the editor).

Photographic plates were exposed to high energy gamma radiation from a synchrotron. The tracks of the electron-positron pairs produced in the plates by the gamma radiation

were then analyzed with respect to their multiple scattering. By this analysis the author determined the energy spectrum of the pairs and thus indirectly that of the primary gamma radiation.

3489 Ellis and Aston's Theory of the Height of a Photoelectron Line. H. O. W. Richardson. Proc. Phys. Soc. (London) 63A, 234-40(1950) Mar. 1.

The formula of Ellis and Aston relating the intensity of a γ ray to the height of its photoelectron line produced from a thick target is revised using the quantum-mechanical theory of stopping power. The effects of multiple scattering, bremsstrahlung, and anisotropic emission of the photoelectrons are discussed and a general comparison of thick and thin target methods is made. (auth)

3490 Gamma-Ray Radiation Monitor. Leonard Reiffel. Electronics 23, 107-9(1950) May.

This paper describes a γ-ray monitor based on an anthracene scintillation counter. The instrument is capable of recording activities ranging from about 1 mr/hr to about 100 r/hr without switching scales. This is accomplished by comparing the photomultiplier output with the output of a potentiometer whose arm is controlled by a servo motor. The servo motor is run by the difference between the photomultiplier output and the comparison voltage, and is geared to a meter so that the position of the potentiometer arm determines the meter reading. The potentiometer is nonlinear, providing a wide range of comparison voltages. A schematic diagram of the circuit is given.

3491 An Improved Nuclear Disintegration Camera. J. H. Sanders. J. Sci. Instruments 27, 100-1(1950) Apr.

A method is described of using photographic plates for the accurate measurement of the yield and angular distribution of fast ionizing particles from a target bombarded by an ion beam, even when the total yield is low. The error due to a small displacement of the beam is largely compensated by the use of two parallel plates, so that it is possible to evaluate the track density to about 1% without introducing any inaccuracy comparable with the statistical error. The construction of a gas target camera using this principle is shown.

3492 Low Voltage Self-Quenching Geiger Counters and Directional Counters. C. Lapointe. Department of Mines and Technical Surveys (Canada) Topical Report No. 43/50, Mar. 1950. 5p. (AEC File No. NP-1468.)

An investigation has been made into the use of dry air as a quenching gas in low voltage, infinite life counters. The use of halogens as quenchers has imposed severe limitations on the choice of cathode material and on the technique of filling. The role of halogens for quenching is discussed, and a filling procedure described. Performance of the tubes with air as a quenching gas is compared to that with chlorine.

3493 On the Response to a Voltage Step-Function of Two Cascaded Differentiating Circuits. W. D. Howell and M. O. Deighton. National Research Council of Canada Report No. CREL-439, Feb. 1950. 14p.

A theoretical analysis is given of the transfer characteristics of a network composed of two CR circuits connected

in cascade and fed with a step-function of voltage. Of particular interest are the properties of overshoot and recovery, here examined in detail, since these have a bearing on the design of Geiger counter and ion chamber input circuits. Curves are given showing the shape of the output pulse for a series of conditions representative of all possible cases. (auth)

3494 Performance of Pulsed Photo-Multiplier Scintillation Counters. R. F. Post and N. S. Shiren. Phys. Rev. 78, 81(1950) Apr. 1 (Letter to the editor).

Several 931-A photomultipliers have been pulsed to voltages as high as 5 kv without breakdown. Stilbene scintillation counts with a rise time of about 10^{-9} sec, and with a maximum height of about 80 v have been displayed on a cathode ray tube without intermediate amplification. Not all of the tubes tried withstood the highest pulse voltages, but those that did gave infrequent and small noise counts. There did not seem to be any consistent correlation between excellence of performance at low d-c voltages and that under high voltage pulse operation. High voltage operation improves the focusing properties of the photomultiplier, and increases the current output at which space charges effects become important. The pulsed scintillation counter could be used in the investigation of extremely short-lived isomeric states.

3495 Print-out Images Produced on Nuclear Photographic Emulsions by α-Particles from Polonium. L. Winand. Bull. soc. roy. sci. Liége 18, 161-3 (1949).

A print-out image was obtained on Ilford C2 (without B) and G5 electron-sensitive plates exposed to α particles from Po. The C2 plates gave a definite image in 20 min and the G5 in 9 min for an exposure to α-particle intensity of about 7×10^5/sec/mm^2. This corresponds for the C2 plates to 25 α particles per grain during the 20 min. Comparison of the energies involved in making a grain developable by α particles and by light quanta with those giving print-out images leads to the conclusion that for a given total energy the α-particle exposure is much less effective than the light exposure in making grains developable.

3496 Quantitative Measurements of the Elementary Process of the Excitation of Light in Luminescent Materials by Single α Particles. I. Immanuel Broser, Hartmut Kallmann, and Claus Reuber. Z. Naturforsch. 5a, 79-85(1950) Feb. (in German).

The scintillations caused by single α particles in various luminescent materials were examined with respect to their duration and manner of decay. It was found that the scintillations are subject to an exponential decay with a time constant ranging from 0.2 to 3.7×10^8 sec^{-1}. Strongly phosphorescent materials were also found suitable for counting α particles. In order to relate their findings for single α particles to similar experiments involving simultaneously a large number of α particles, the authors make the assumption that in phosphorescent substances there occurs after the brief scintillation a considerably longer "instantaneous phosphorescence" which, in turn, is followed by the phosphorescence proper.

3497 Terphenyl and Dibenzyl Scintillation Counters. R. Hofstadter, S. H. Liebson, and J. O. Elliot. Phys. Rev. 78, 81(1950) Apr. 1 (Letter to the editor).

The author has tabulated the decay constants and melting points of anthracene, stilbene, terphenyl, and dibenzyl, and the counting efficiency of these substances with respect to the efficiency of anthracene. Both terphenyl and dibenzyl have many properties which are desirable in scintillation counters. The speed, good handling characteristics, and pulse height of terphenyl should make it especially useful.

3498 Ultra-Sensitive Portable Gamma-Ray Spectrometer. Robert W. Pringle, Kenneth I. Roulston, and George M. Brownell. Nature 165, 527(1950) Apr. (Letter to the editor).

The authors report the construction of a new type of portable detector to be used in prospecting for uranium. A crystal of approximately 100 g is used as a gamma-sensitive scintillation element and, with an integration time for counting of a few seconds, a detection sensitivity of 10^{-10} r/sec was obtained. The device also acts as a crude gamma-ray spectrometer, since the differential pulse height distribution gives a measure of the energies of the gamma rays. Photoelectron conversion lines and Compton recoil "edges" are employed to identify these energies. Thorium is easily identified by the Compton recoils due to the strong 2.62-Mev gamma ray. The counter was successfully operated in a radiation survey of the Lake Athabaska and Black Lake districts in northern Canada.

3499 Annual Report, 1949. G. H. Dieke. John Hopkins University Report No. JHU-4, Feb. 1, 1950. 43p.

This report summarizes the work carried out during the past year on the spectra of hydrogen molecules containing tritium and on related subjects. The purpose of the work was to determine the detailed structure of the hydrogen molecule by studying its spectrum. The immediate object of the work was to photograph the spectra of TH, T_2, and TD and analyze them. The progress is reported in the following sections: discharge tubes, photography of the spectrum, impurities, wavelength measurements, analysis of the spectra, measurement of intensities, work on D_2, the molecular spectrum of He_2, and the general outlook. Appendix 1 is a bibliography of 149 references to papers on the molecular spectra of hydrogen since 1922. Appendix 2 is a paper entitled: The Molecular Spectrum of He^3, by G. H. Dieke and E. Robinson.

3500 Deuterons Bombarded by 90-Mev Neutrons. Walter Hartsough, Milton Hill, and Wilson M. Powell. UCRL-611, nd. 1p.

The document is in abstract form; it is reproduced below in its entirely.

A deuterium-filled Wilson cloud chamber in a 21,700-gauss field was bombarded by 90-Mev neutrons produced by 190-Mev deuterons bombarding a half-inch thick beryllium target. The deuterons in the cloud chamber are elastically scattered one third of the time and show a sharp peak in the forward direction in accord with "pickup" theory (Chew and Goldberger, Phys. Rev. 77, (1950)), a valley at 30 deg, and another peak at 80 deg. The proton fragments show a broader peak forward, reaching half value at 35 deg. A few protons go backwards, and one might interpret these as the residue of neutron-neutron collisions (UCRL-612). They amount to about 5 per cent of the total number of events and may be used to obtain a rough estimate of the total neutron-neutron cross section relative to that of the deuteron (Cook et al, Phys. Rev. 75, 7(1949)).

3501 The Inelastic Scattering of High Energy Neutrons by Deuterons and the Neutron-Neutron Interaction. Geoffrey F. Chew. UCRL-612, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Because elastic scattering represents a considerable fraction of the total n-d cross section even at high energy (Chew, Phys. Rev. 74, 809(1948); UCRL-611), it is dangerous to assume that the latter is composed additively of n-p and n-n cross sections. Nonadditive effects are less important in inelastic scattering, however, and one may attempt to derive information about the high energy n-n cross section from an observation of the disintegration protons. A theoretical approach has been developed to relate n-d inelastic scattering to free n-p and n-n scattering cross sections at the same energy without reference to the nature of nuclear forces. The method depends on the short range of nuclear forces and on the smallness of two-body cross sections compared to the size of the deuteron but is not a Born approximation. Analysis of Powell's preliminary data (UCRL-611) on this basis indicates the 90-Mev n-n cross section to be less than 15 mb. Since the proton-proton cross section at 350 Mev is ~ 30mb (Chamberlain and Wiegand, Bull. Am. Phys. Soc. 25, No. 1, H-6(1950)), doubt is cast on the equality of n-n and p-p interactions at high energies.

3502 Information Obtained from the Interaction of Slow Neutrons with Matter. James Rainwater. Trans. New York Acad. Sci. 2, 72-80(1949) Jan.

After a preliminary theoretical discussion of neutron production and action, a description of the experimental method is given; the results of using thick and thin paraffin sources of slow neutrons are graphed with respect to the relative intensities of timed neutrons, their time of flight, the time interval after the cyclotron burst and the energy of the neutrons for a cadmium and a tantalum cross section at various energy levels obtained. The results are interpreted in terms of configurations and evaluations of neutron-proton forces, and are discussed in terms of theoretical implications; the author concludes that other data suggested must be fitted by an adequate meson theory.

3503 Molecules Formed by the Neutron Irradiation of Organic Bromides. Pierre Süe and Andrée Nouaille. Compt. rend. 230, 954-6(1950) Mar. 6 (in French).

This article discusses the results of neutron bombardment of organic compounds, which contain bromide. As examples for his investigation, the author chose C_2H_5Br and $C_2H_4Br_2$, and attempts to explain how irradiation affects the groups C_2H_5 and C_2H_4. He assumes that under the influence of irradiation, C_2H_5 and C_2H_4 are decomposed and that the decomposition products react with the irradiated bromine and new brominated compounds are formed. In order to prove this hypothesis, the author distilled irradiated C_2H_5Br and also $C_2H_4Br_2$ with a hydrocarbon mixture (C_6-C_{14}); typical distillation curves are shown, which were caused by the formation of CH_2Br_2 and CH_2Br-CH_2Br from irradiated C_2H_5Br, and of CH_2Br_2 and

PHYSICS

$CHBr_2-CHBr_2$ from irradiated $C_2H_4Br_2$, which products the author could identify.

3504 Resonance and Thermal Neutron Scattering in V^{51}. M. Hamermesh and C. O. Muehlhause. Phys. Rev. 78, 175(1950) Apr. 15 (Letter to the editor).

The authors compare the values of the resonance neutron scattering cross section in V^{51} as reported by Harris, Hibdon, and Muehlhause with the coherent thermal scattering cross section of neutrons in V^{51} as determined by Shull and Wollan (Naturwissenshaften 10, 291(1949)). The correlation between these two experimental cross sections is found in agreement with that predicted by the Breit-Wigner scattering theory.

3505 Scattering of 90-Mev Neutrons by Alpha Particles. Calculations. Jean Heidmann. Compt. rend. 230, 724-5(1950) Feb. 20 (in French).

The author reports, briefly, the results of calculations relating to the scattering of 90-Mev neutrons by α particles. These results may be useful in studying the action of such neutrons on the lighter elements, with the aid of Wheeler's α - particle model (Phys. Rev. 52, 1083(1937)). The Born approximation was used in the calculations, the individual nucleons were assumed to interact with the nucleon-nucleon potential introduced by Serber. The following types of transitions were treated: elastic scattering, scattering of the neutron with a proton knocked out of the helium nucleus, and scattering with the creation of a deuteron. Total cross sections are given for these processes, and the angular distributions of the resulting particles are described.

3506 The Nobel Institute for Physics Research at Stockholm. M. E. Bell. Office of Naval Research, London Branch, Technical Report No. OANAR-21-50, Feb. 2, 1950. 6p.

A description is given of the laboratory facilities and of a number of the machines used. Selected portions of the research program are discussed briefly. The discussions are presented under the following topics; ruling of gratings, electron microscopy, cyclotrons, β-ray spectrometers, molecular vacuum pumps, nuclear magnetic moment measurements, Cockroft-Walton generator, and other research.

3507 The H.F.S. Anomaly of the Potassium Isotopes. S. A. Ochs, R. A. Logan, and P. Kusch. Phys. Rev. 78, 184(1950) Apr. 15. (Letter to the editor).

The authors observed the hyperfine structure (hfs) spectrum of K^{39} and K^{41} in a magnetic field of about 12,000 gauss, and obtained a hfs ratio $(\Delta\nu^{39}/\Delta\nu^{41}) = 1.81768 \pm 0.00001$. Moreover,

$$\Delta \equiv \frac{(\Delta\nu^{39}/\Delta\nu^{41})_{obs} - (\Delta\nu^{39}/\Delta\nu^{41})_{calc}}{(\Delta\nu^{39}/\Delta\nu^{41})_{calc}} = -(0.226 \pm 0.010)\%$$

If the nucleus is assumed to be a point dipole which interacts with the magnetic field produced by the electrons, then Δ should be equal to zero. But if a nucleus of finite extent is considered, the interaction of the electron with the nucleus over that portion of the electron orbit which lies within the nucleus will depend on the distribution of the magnetic momenta within the nucleus, and an observable value of Δ may appear for two different isotopes. The bearing of the observed value of A on various nuclear-models is discussed.

PHYSICS

3508 Maximum Mass Numbers of Stable Nuclei. John Tutin. Nature 165, 442(1950) Mar. 18 (Letter to the editor).

A plot is given of the maximum mass number of the stable nuclei as a function of the atomic numbers of the nuclei. This plot turns out to be a straight line with slope of $\frac{5}{2}$ from Z = 16 to Z = 72. From 72 to 80 the slope changes to 3, and at 80 it goes back to $\frac{5}{2}$. From the fact that the gradient of this curve is nearly constant at $\frac{5}{2}$ throughout its length, the author concludes that a saturation field may exist between an α particle and a neutron.

3509 Nuclear Abundances and Closed Shells in Nuclei. R. A. Brightsen. Nucleonics 6, 14-24(1950) Apr.

The experimental evidence and recent theories of nuclear shell structure are reviewed. The author reaches the conclusion from the derived proton and neutron stability patterns that the "magic numbers" that represent closed proton shells do not necessarily represent closed neutron shells, although certain numbers are common to both (16, 28, 50, and 82). The correlations between closed shells in nuclei and nuclear abundances have been demonstrated, but in the author's opinion many details and problems remain unanswered. Among these is distribution of the nuclei at some elapsed time after the formation of the elements which is short compared to the half-lives of certain nuclides now known artificially (Se^{79}, Zr^{93}, Pd^{107}, and I^{129}.)

3510 Nuclear Configurations in the Spin-Orbit Coupling Model. II. Theoretical Considerations. Maria Goeppert Mayer. Phys. Rev. 78, 22-3(1950) Apr. 1. (See also NSA 4-3184.)

The assumption of short-range attractive forces between identical nucleons in the j j coupling model of nuclear structure is in agreement with the empirically observed spins. (auth)

3511 Nuclear Magnetic Moments of the Gallium Isotopes. G. J. Béné, P. M. Denis, and R. C. Extermann. Phys. Rev. 78, 66(1950) Apr. 1 (Letter to the editor).

In their survey of nuclear magnetic moments, H. Taub and P. Kusch (Phys. Rev. 75, 1481(1949)) noticed a discrepancy between the moments of the isotopes of gallium as determined from spectroscopic data and from magnetic resonance experiments. This discrepancy is real and is well beyond the limits of the experimental errors. By applying to the spectroscopic values the Rosenthal-Breit (Phys. Rev. 41, 459(1932)) and Kopfermann (Kernmomente, Leipzig, 1940, p. 17) corrections, assuming a spreading of the charge over the whole nuclear volume, this discrepancy is eliminated.

3512 The Possible Existence of a Constant Third-Order Difference Among the Nuclear Magic Numbers. Frank A. Valente. Phys. Rev. 78, 77(1950) Apr. 1 (Letter to the editor).

There seems to be some indication that a constant third-order difference may possibly exist among the nuclear magic numbers. If, according to the explanation afforded by the linear oscillator of the nuclear model (Haxel et al, Phys. Rev. 75, 1766(1949)), these numbers are taken to be 14, 28, 50, 82, and 126, then the first-order differences

PHYSICS

among them are 14, 22, 32, 44; the second-order differences, 8, 10, 12; and the third-order difference is constant at a value of 2. On the assumption that this constant value of the third-order difference is a fundamental fact, the magic number, M, is computable from the readily derivable expression $M = (N^3 + 5N)/3$ in which N assumes the integer values 1, 2, 3, 4, 5, 6, 7, 8, etc. Then, according to this rule, the magic numbers should be 2, 6, 14, 28, 50, 82, 126, 184, etc.; 8 and 20 are notably absent. The terminal point of the series occurs, of course, at the magic number beyond which all others are proven or known to be physically impossible. (auth)

3513 Remark on the Selection Rules Relating to be Forbidden β Transitions. Roger Nataf. Compt. rend. 230, 532-4(1950) Feb. 6 (in French).

Selection rules and transition probabilities have been calculated by Marshak (Phys. Rev. 61, 431(1942)) for the Gamow-Teller type of interaction. The results of his calculations are given. The authors have repeated these calculations, using the following assumptions; relativistic corrections and noncentral forces may be neglected and a Pauli representation maybe used for the nuclear wave function. Slightly different selection rules and transition probabilities result, and these are tabulated. Forbidden transitions are classified according to the change in nuclear orbital angular momentum. This appears to be the simplest classification scheme. The changes introduced by relativistic corrections are discussed.

3514 A Table of Nuclear Moments, Janurary 1950. J. E. Mack. Revs. Modern Phys. 22, 64-76(1950) Jan.

This paper contains a table, prepared at the beginning of 1950, of the value of the mechanical or spin moment, and the most probable values of the magnetic dipole moment and electric quadrupole moment for the normal state of each nuclear species. The table is accompanied by a brief expository text, devoted in large part to a discussion of various correction factors, including the diamagnetic, chemical, radiative, relativistic, reduced mass corrections as well as those due to nuclear size and structure. More than 300 literature references.

3515 The Pile as a Service Instrument for Chemical Analysis. C. O. Muehlhause and G. E. Thomas. AECU-832, nd. 19p. (For Publication in the June 1950 issue of Nucleonics.)

In a neutron radiation laboratory, chemical identification may be effected by activation (β^-, e^-, β^+, γ, x), thermal and resonance neutron scattering and absorption, and by other special means. These methods are rapid and highly sensitive, but in general should be reserved for difficult two-component cases. There is need and opportunity for exploitation of the methods of "nuclear" analysis. Both of these factors exist in all radiation laboratories possessing nuclear reactors, cyclotrons, or betatrons. Of these, the pile is the outstanding service instrument for this work. (auth)

3516 Fission Product Yields. K. Way and N. Dismuke. AECD-2817, Aug. 29, 1949, Decl. Mar. 21, 1950. 50p.

This report is a summary of all the available information concerning yields of fission products as of June 1949. 46 references.

PHYSICS

3517 Preparation of Transplutonium Isotopes by Neutron Irradiation. A. Ghiorso, R. A. James, L. O. Morgan, and G. T. Seaborg. AECD-2822, Feb. 28, 1950, Decl. Mar. 23, 1950. 3p.

This is not an abstract; the document is reproduced below in its entirety.

The first production of isotopes of the transplutonium elements americium (atomic number 95) and curium (atomic number 96) was reported (Seaborg, Chem. and Eng. News 23, 2190(1945)) by the present authors in a preliminary way in 1945 and more recently (Seaborg et al, The Transuranium Elements, NNES Div. IV, Vol. 14B, New York, McGraw-Hill, 1949) in a more complete fashion. In these communications it was pointed out that a number of americium isotopes may be formed in cyclotron bombardments with various charged particles and in particular that the ~500-yr Am^{241} may be produced with approximately 40-Mev helium ions according to the reactions $U^{238}(\alpha,n)Pu^{241} \xrightarrow{\beta^- (10\ yr.)} Am^{241}$. It was also reported that a number of curium isotopes may be formed by cyclotron bombardments with charged particles and in particular that the 150-day Cm^{242} may be prepared by the 40-Mev helium ion bombardment of Pu^{239} according to the reaction $Pu^{239}(\alpha,n)Cm^{242}$. It was also pointed out that Cm^{242} may be formed by neutron irradiation of Am^{241} according to the reactions $Am^{241}(n,\gamma)Am^{242} \xrightarrow{\beta^-} Cm^{242}$ where Am^{242} exists in two isomeric states with half-lives for beta-emission given as 17 hr and some 10^2 to 10^3 yr.

The purpose of the present note is to point out that the isotope Am^{241} may also be formed by neutron irradiation, according to the following reactions $Pu^{239}(n,\gamma)Pu^{240}(n,\gamma)Pu^{241} \xrightarrow{\beta^- (10\ yr)} Am^{241}$. This method of production was first observed by the authors of this note late in 1944 and the use of the the chain reacting piles as a source of neutrons makes it the best for the production of weighable amounts of Am^{241}. (The first evidence for the reaction $Pu^{239}(n,\gamma)Pu^{240}$ was that of Chamberlain, Farwell, and Segre.) In fact, the intense irradiation of large quantities of plutonium leads to the production of milligram amounts of Am^{241}. The cross section of Am^{241} for the n,γ reaction is such that it is possible with long irradiations at high neutron fluxes to transmute a substantial fraction of it to Cm^{242}.

The fact that the elements americium and curium, as represented by their isotopes Am^{241} and Cm^{242}, may be prepared in substantial quantity in this manner by pile neutron irradiations makes it possible to investigate rather completely the chemical properties of these elements using weighable amounts. The existence of these reactions makes it quite likely that even higher mass isotopes may be prepared by n,γ reactions and in fact further work at this laboratory, to be published soon, indicates that this is indeed the case.

3518 Transition Curves of 330-Mev Bremsstrahlung. Wade Blocker, Robert Kenney, and Wolfgang K. H. Panofsky. UCRL-565, Mar. 27, 1950. 37p.

Transition curves produced by 330-Mev bremsstrahlung from the Berkeley synchrotron have been measured in carbon, aluminum, copper, and lead. The measurements were made by a thin ionization chamber "immersed" in the materials under study. The results are in agreement with expected shower behavior. An important part of this investigation was to provide a suitable means for standardizing the synchrotron beam. This is accomplished in two ways: (1) the area of the shower curves gives a good measure of

the beam energy and (2) analysis of transition curves with thin converters permits separation of Compton and pair electron ionization. The pair ionization can be compared with theory and the primary energy deduced. Agreement between these methods is very good. As a result of these measurements absolute cross section measurements in the synchrotron beam are possible. 15 references. (auth)

3519 Nuclear Reactions Induced by High Energy X-rays. Karl Strauch. UCRL-620, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Using the x-ray beam from the 335-Mev Berkeley synchrotron the average photon energy responsible for several nuclear reactions has been measured by the transition curve method previously described (Strauch, Bull. Amer. Phys. Soc. 24, No. 8, 8(1949); Eyges, Bull. Amer. Phys. Soc. 24, No. 8, 8(1949)). Results to date are: $C^{12}(\gamma,n)C^{11}$ 30 Mev; $Cu^{63}(\gamma,n)Cu^{62}$ 20 Mev; $Zn^{64}(\gamma,n)Zn^{63}$ 21 Mev; $Ag^{107}(\gamma,n)Ag^{106}$ 18 Mev; $Zn^{64}(\gamma,2n)Zn^{62}$ 32 Mev; $Zn^{64}(\gamma,pn)Cu^{62}$ 34 Mev; Ta^{181} $(\gamma,2p...)$ 70-min Rare Earth 70 Mev. Unidentified short half-lives are produced in Bismuth and Lead by 90-Mev photons. The relative yield of several reactions has been determined; taking the $C^{12}(\gamma,n)C^{11}$ yield as 1.0 we obtain: $Zn^{64}(\gamma,n)Zn^{63}$ 11; $Zn^{68}(\gamma,p)Cu^{67}$ 1.2; $Zn^{64}(\gamma,2n)Zn^{62}$ 0.7; $Zn^{64}(\gamma,pn)Cu^{62}$ 3.3; $Zn^{66}(\gamma,3n)Zn^{63} < 0.4$; $Zn^{64}(\gamma,p2n)Cu^{61}$ 0.55. Further measurements will be presented and these results will be discussed with respect to the several models for x- ray induced reactions that have been proposed.

3520 Carrier-Free Radioisotopes from Cyclotron Targets. VIII. Preparation and Isolation of $Cu^{64,67}$ from Zinc. Herman R. Haymond. Roy D. Maxwell, Warren M. Garrison, and Joseph G. Hamilton. UCRL-639, Mar. 27, 1950. 4p.

Radio-copper was produced by bombardment of zinc with 19-Mev deuterons in the 60-in. cyclotron. At this energy the longer lived radioisotopes of copper, $Cu^{64,67}$ are produced in a thick target by the nuclear reactions $Zn^{64}(d,2p)Cu^{64}$, $Zn^{68}(d,\alpha)Cu^{64}$, and $Zn^{67}(d,2p)Cu^{67}$. Radioisotopes of gallium are produced concurrently by the reactions Zn(d,xn)Ga. The carrier-free radiocopper was separated from the target element and from the radioisotopes of gallium by a solvent extraction method based on the selective solubility of copper dithizonate in carbon tetrachloride. This procedure (Sandell, Colorimetric Determination of Traces of Metals, New York, Interscience Publishers, 1944), originally developed for the colorimetric determination of μg quantities of copper, quantitatively extracted $Cu^{64,67}$ from solutions containing less than approximately 10^{-8} g of copper, the minimum amount detectable by colorimetry under the experimental conditions used. The radio-copper was identified by half-life determination, absorption measurement, and by chemical separation with carriers. The decay curve was followed for 500 hr and showed the 12.8-hr period of Cu^{64} and a longer-lived activity which after 100 hr leveled off into a 72-hr period. This activity, presumably Cu^{67}, was followed for four half-lives and accounted for approximately 3.0% of the total β activity corrected to the time of bombardment. Absorption measurements 10 hr after bombardment showed the 0.6-Mev β particle and 1.2 Mev γ ray of Cu^{64}. A tracer amount of activity added to a 1N HCl solution of Ni, Cu, and Ga in carrier amounts was quantitatively recovered in the CuS fraction following precipitation with H_2S.

3521 Angular Correlation in the Reaction $B^{10}(n,\alpha)Li^{7*}(\gamma)Li^7$. B. Rose and A. R. W. Wilson. Phys. Rev. 78, 68(1950) Apr. 1 (Letter to the editor). (See also NSA 2-1135.)

The authors have measured the angular correlation between the α and γ rays in the slow nuclear reaction $B^{10}(n,\alpha)Li^{7*}(\gamma)Li^7$, by means of the following experimental arrangement: A uniform 1.4-cm square B^{10} foil of thickness ~0.3 mg/cm^2 was irradiated with neutrons from the Harwell pile, the α particles emitted at right angles to the neutron beam entering a proportional counter through a 1.4-cm square grid, distant 3.2 cm from the foil. The γ rays emitted at right angles to the neutron beam were detected in the 37-mm diameter crystal of a scintillation counter which could be rotated about the neutron beam, the distance of the mid-plane of the crystal from the boron film being about 6 cm. The degree of correlation was determined by measuring the α-γ coincidence rate at 20 different angles between the axes of the counters. The results give a correlation coefficient of $-0.9 \pm 1.2\%$. This rules out all correlations listed by Feld (Phys. Rev. 75, 1618(1949)) and by Devons (Proc. Phys. Soc. (London) 62A, 580(1949)) with the exception of the spherically symmetrical, and those resulting from mixed transitions over very limited ranges of the mixtures. There is, therefore, no evidence from this experiment that the spin of the Li^{7*} state involved is not ½.

3522 The Effective Range of Nuclear Forces. II. Photo-Disintegration of the Deuteron. H. A. Bethe and Conrad Longmire. Phys. Rev. 77, 647-54(1950) Mar. 1. (See also NSA 3-1266.)

The theory of the effective range is applied to the photo-disintegration of the deuteron. For the photoelectric effect, the only important influence of the range is through the normalization of the ground state wave function. The authors find that this is given by an energy-independent factor $(1-\gamma r_{ot})^{-1}$, where r_{ot} is the effective range of the forces in the triplet state, and γ is related to the binding energy of the deuteron. With the most likely experimental constants, this factor is 1.58, irrespective of the shape of the nuclear potential. In the photomagnetic case, the effect of the range on the matrix element nearly compensates that on the normalization. The cross section is thus nearly the same as for zero range of the forces. However, the cross section is sensitive to the difference of the effective ranges for triplet and singlet state, and can thus be used to determine the latter (r_{os}). The capture of slow neutrons by protons gives $r_{os} \approx 2.6 \pm 0.6 \times 10^{-13}$ cm, in good agreement with the proton-proton scattering results. In the last section, it is shown that the effect of tensor forces is unimportant. (auth)

3523 Element 97. S. G. Thompson, A. Ghiorso, and G. T. Seaborg. Phys. Rev. 77, 838-9(1950) Mar. 15 (Letter to the editor).

Good evidence has been obtained for the identification of an isotope of the element with atomic number 97 through the irradiation of Am^{241} with helium ions in the Berkeley 60-in. cyclotron. The particular isotope discovered is thought to be 97^{243}, or possibly 97^{244}, decaying with a 4.8-hr half-life by electron capture

with approximately 0.1% α decay branching. There seem to be three α-particle groups associated with the activity, the highest energy being 6.72 Mev. It has been suggested that the new element be given the name berkelium (symbol Bk).

3524 The Emission of Short-range α Particles from Light Elements Under Proton Bombardment. Further Observations on the Reaction $B^{10}(p,\alpha)Be^7$. W. E. Burcham and Joan M. Freeman. Phil. Mag. 41, 337-48 (1950)Apr. (See also NSA 3-1416.)

The energy release in the reaction $B^{10}(p,\alpha)Be^7$ has been measured, using targets of known thickness, and found to be 1.147 ± 0.10 kev. Evidence for the existence of an excited state of energy about 400 kev in the Be^7 nucleus was obtained. The crosssection for the reaction was found by comparing the yield of α particles with the yield from the $B^{10}(n,\alpha)Li^7$ reaction observed with the same target. A value of 4.5×10^{-27} cm^2 at 330-kev proton energy was found. (auth)

3525 A Study of the Energy of Protons Produced During the Bombardment of Fluorine and Sodium with Deuterons. Yu. A. Nemilov and L. I. Gedeonov. Doklady Akad. Nauk. S.S.S.R. 70, 219-20(1950)(in Russian).

Using the technique described in previous papers (Doklady Akad. Nauk. S.S.S.R. 63, 115(1948); ibid. 66, 369(1949)), energy levels of F and Na were determined. CaF_2, Na_2CO_3, NaBr, and NaI were irradiated with 3.9-Mev deuterons, and the liberated protons, after they have traversed a wedge-like Al filter (2 to 60 cm air equivalent), were allowed to act upon a photographic plate; the various shades of the darkening of the plate permitted the determination of the energy of various groups of protons formed furing the reactions $F^{19}(d,p)F^{20}$ and $Na^{23}(d,p)Na^{24}$; this was followed by a calculation of the corresponding energy levels of F^{20} and Na^{24}, as well as of their atomic masses. Thus it was found that the atomic mass of the isotope F^{20} is 20.0064 ± 0.0010; it has been known until now that this mass must lie somewhere between 20.0042 and 20.0092. The determination of the atomic mass of Na^{24} gave the value 23.9964 ± 0.0008; the generally accepted value being 23.99618 ± 0.00031, the trustworthiness of the authors method is manifast. The excited levels of F^{20} are 1.08, 2.52, 3.29, and 3.93 Mev; however, it is not altogether certain that the last three values are not due to the reaction $O^{16}(d,p)O^{17}$. The levels of Na^{24} are 0.71 and 1.67 Mev.

3526 Electron-Optical Properties of Homogeneous Magnetic and Radial Electric Fields. A. A. Garren and Lloyd Smith. UCRL-599, Feb. 8, 1950. 34p.

For various purposes it is often desired to change the direction or alter the characteristics of a given beam of ions. This can be done with various combinations of magnetic and electric fields, of which a homogeneous magnetic field and a radial electric field, such as is found inside an electrostatic deflector, are among the easiest to produce. It is the purpose of this report to summarize the optical properties of these two types of fields, and of various combinations thereof. It is always assumed that the electric and magnetic fields are perpendicular wherever they are superimposed, are plane bounded, and that the beam is in what shall be called the horizontal plane, which is defined as the plane perpendicular to the magnetic field and/or parallel to the electric field. The discussion is confined

to effects of the first order in the deviations in position, direction, velocity, and mass of the ions from reference values. The theory of focussing effects in the horizontal plane is based on a paper by R. Hertzog (Zeits f. Phys. 89, 447(1934)), who was interested chiefly in applications to mass spectroscopy. Parts of his discussion have been generalized somewhat; further the focussing effects in the vertical plane (the plane parallel to the magnetic field and/or perpendicular to the electric field) are given. All optical properties are expressed by equations which show the analogy with thick lenses, and so far as possible Hertzog's notation has been used. Lastly some discussion of the application of the theory to the problem of injection into the bevatron has been included. (auth)

3527 The Cyclosynchrotron. Acceleration of Heavy Particles to Energies Above 1,000 Mev, and the Homopolar Generator as a Source of Very Large Current Pulses. M. L. Oliphant. Nature 165, 466-8(1950) Mar.

The author points out the advantages of the injection of particles into the synchrotron orbit at very high energies, and describes a method of achieving this by first accelerating protons in a synchro-cyclotron and then producing a synchrotron guiding field about the final orbit, in such a way that the synchrocyclotron acceleration passes smoothly over into synchrotron acceleration. An accelerator operating in this manner is called a "cyclo-synchrontron." Details of a model now under construction are described.

3528 The Effect of Doughnut Height and Gun Emission on the Output of a Betatron. J. D. Lawson. Atomic Energy Research Establishment Report No. AERE-Memo-E1/M2, Feb. 23, 1949. 4p.

Experiments on the Malvern 30-Mev synchrotron are described which show what happens to the output of a betatron as the vertical aperture of the doughnut is constructed under different operating conditions. It is found that when the aperture is reduced below a certain critical value the betatron output falls to zero. A crude theory is advanced which would partly explain both the result and also the fact that the gun emission must reach a critical value before any output occurs. Finally, the significance of these results in the relation to the design of large machines is discussed. (auth)

3529 Distribution of Ionization in Materials Irradiated by Two and Three Million-Volt Cathode Rays. J. G. Trump, K. A. Wright, and A. M. Clarke. J. Applied Phys. 21, 345-8(1950) Apr.

Measurements are reported on the distribution of ionization in depth of aluminum produced by steady beams of two and three million-volt electrons. The variation of cathode-ray current density in a plane transverse to the beam, the effect on this transverse distribution of additional aluminum scattering foils, and a practical method of cathode-ray dosage computation are given. (auth)

3530 Inelastic Scattering of 30-Mev Protons from Carbon and Aluminum. Albert Silverman. UCRL-567, nd. 45p.

PHYSICS

Nuclear energy levels have been investigated by inelastic scattering of protons. The energy distribution among the protons inelastically scattered by C^{13} and Al^{27} was used as a measure of the energy level distribution in the product nuclei. The protons from a linear accelerator were recorded, after scattering, in Ilford E-1 100 μ emulsions and their distribution in range was determined. In the case of C^{12}, discrete energy levels were found at 4.7 and 10.1 Mev, both with 16.3 and 31.5-Mev proton beams. In the case of Al^{27}, however, a 30.4-Mev beam showed a continuum of levels in the nucleus. 19 references.

3531 On Straight-Ahead γ Transmission with a Mininum in the Cross-Section. Gale Young. ORNL-416, Sept. 26, 1949. 12p.

Solutions of the attenuation problem have previously been obtained by Greuling, using certain assumptions about the law of scattering and the variations of cross sections with energy. His results, as they stand, do not include instances where the cross section can (as with γ rays) go through a minimum as the energy varies. The present note illustrates how different Greuling solutions can be pieced together to construct cases having a minimum.

3532 Energy Dependence of Proton-Proton Scattering Over the Interval of 19 to 32 Mev. Bruce Cork. UCRL-621, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Measurements have been made of the absolute differential cross section of proton-proton scattering at 90 deg in the center of mass system. The energy of the incident proton from the linear accelerator was varied from 32 Mev down to 19 Mev and an energy interval of ± 0.5 Mev was selected by means of a deflecting magnet. Apparatus using proportional counters and a triple coincidence method was used to reduce the background. Measurements were made simultaneously using the apparatus (UCRL-482) for measuring the angular distribution at 31.8 Mev, and a single charge integrator for collecting the incident proton beam. The cross section at 90 deg center of mass varies approximately as the reciprocal of the energy of the incident protons. Data will be presented to show this dependence.

3533 An Approach to the Problem of Scattering of High Voltage Radiation in Non-Homogeneous and Limited Media. L. F. Lamerton and Margaret Winsborough. Brit. J. Radiol. 23, 236-44(1950) Apr.

A theoretical approach to the problem of scatter in a non-homogeneous medium is made on the basis of isocontribution curves, calculated for given conditions of radiation. Isocontribution curves drawn round a given point are the curves along which equal elements of volume of the medium will scatter equal amounts of radiation to the given point. The application of these curves to certain problems of air-spaces and bones within the medium is indicated. The approximate nature of the calculation involved in this treatment is stressed, but it is thought that the results may be of use as a guide in further experimental work. Another application of the isocontribution conception is described which enables the depth dose at any point in a medium irradiated by an irregularly-shaped field to be determined with much less labor than has previously been necessary.

PHYSICS

3534 On the Scattering and Absorption of Fluorescence Radiation in Sheets of Polycrystalline Fluorescent Substances Excited by Energetic Quanta and Corpuscular Radiation. Immanuel Broser. Ann. Physik 5, 401-16(1950)(in German).

The light intensity emitted by an excited sheet of fluorescent material depends on the absorption coefficient of the material for the exciting radiation, on the intensity produced by unit intensity of the exciting radiation in the material (the absolute yield), on the absorption and scattering constants of the material for the fluorescence radiation, and on the thickness of the sheet. Differential equations relating these quantities are set up and solved for special types of excitation. By means of measurements made on various substances excited by α and γ rays, the author shows that these equations are very good approximations to the actual situation. Scattering and absorption constants are calculated for ZnS−Cu phosphors and these are shown to be independent of the type of excitation. These investigations provide a method for determining the absolute yield of phosphors and for the analysis of energy spectra of particles and quanta. In conclusion, measurements relating to the effect of the particle size on the scattering and absorption coefficients are described and discussed.

3535 Paramagnetic Resonance Absorption in Crystalline Powders of Certain Rare-Earth Compounds. S. A. Al'tshuler, V. Ya. Kurenev, and S. G. Salikhov. Doklady Akad. Nauk S.S.S.R. 70, 201-4(1950)(in Russian).

The resonance paramagnetic absorption in solids has been studied, so far, only (1) in salts of the iron-group metals (Zavoĭskiĭ, Zhur. Eksptl. i Teoret. Fiz. 15, 253 and 344(1945)), and (2) in substances containing free radicals (Kozyrev et al, Doklady Akad. Nauk S.S.S.R. 58, 1023 (1947)). In all these cases the influence of the intracrystalline electric field is stronger than the interaction between the spin and the orbital momenta of the ion's electronic shell; the orbital momentum is thereby repressed and the paramagnetic absorption of energy is determined by the spin alone. It appeared interesting to investigate the behavior of rare-earth salts, in which the crystal field is unable to affect the coupling between the orbital and the spin momenta of the deeply lying 4f-electrons of the "magnetic" ion. The authors examined the paramagnetic absorption of various salts (sulfates, nitrates, etc.) of Ce, Pr, Nd, Er, and Sm, the absorbed energy being measured by its reaction upon the frequency generator whose field was placed perpendicularly to a constant magnetic field H. All the curves given correspond to a frequency 6.75×10^8 hertz and show the absorption as a function of H which varied between 200 and 3,000 oersted; each of the curves exhibits only one wide maximum, the interpretation of which is attempted in the light of a theoretical computation of the splitting of energy levels in the presence of symmetrical crystalline electric fields (see Penney and Schlapp, Phys. Rev. 41, 194(1932); Spedding, J. Chem. Phys. 5, 316 (1937)). It is surmised that measurements at considerably higher frequencies would be required in order to resolve the wide maxima shown here into individual maxima corresponding to transitions between the split levels; this would permit a more satisfactory insight into the true symmetry of the intracrystalline fields.

PHYSICS

3536 The Scattering of Electrons by Hydrogen Atoms. H. S. W. Massey and B. L. Moiseiwitsch. Phys. Rev. 78, 180-1(1950) Apr. 15 (Letter to the editor).

This is a preliminary report of a calculation of the scattering of electrons by hydrogen atoms according to the variational method of Hulthen (Kgl. Fysiograf. Sällskap. Lund Förh. 14, No. 21 (1944)). The zero-order phase angles were determined taking into account polarization and exchange corrections.

3537 Scattering of Pseudoscalor Charged Mesons by Nucleons. II. E. Corinaldesi and G. Field. Phil. Mag. 41, 364-9(1950) Apr.

Evaluation of the fourth-order and sixth-order contributions, σ_4 and σ_6, to the total cross section for the scattering of a pseudoscalar charged meson by a nucleon was previously reported by the authors and abstracted as NSA. 4-572. A more refined treatment is now applied to find σ_4 and σ_6 in terms of the coupling constant g^2. A further correction to the cross section is obtained by consideration of the damping reaction of the emitted meson on the nucleon motion. Curves are drawn to indicate the energy dependence of the cross section, using the various values of g^2 which have been proposed in the literature.

3538 Simultaneity in the Compton Effect. Robert Hofstadter and John A. McIntyre. Phys. Rev. 78, 24-8(1950) Apr. 1.

The Bothe-Geiger experiment has been repeated under improved conditions of time resolution, obtained by using stilbene scintillation counters. The recoil electron and scattered photon are emitted together within a time interval of less than 1.5×10^{-8} sec. The electron and photon are also projected without a delay larger than 1.5×10^{-8} sec after arrival of a quantum. The familiar concepts used in discussions of the Compton effect are shown to be valid. (auth)

3539 Evidence for the Formation of Ce^{139} by an n-γ Reaction. Alfred J. Moses and Don S. Martin, Jr. ISC-77, Mar. 20, 1950. 14p.

A radioactivity found in old samples of pile-irradiated cerium is attributed to Ce^{139} (140d) formed by an n-γ process. This activity had a half-life of greater than 120 days, and absorption curves indicated it possessed a larger component of x-rays than the more abundant Ce^{141} (28d). The activity followed Ce in chemical separations from La, Ca, Ba, Pb, Fe, and Zn. The ratio of cross sections, $\sigma_{139}/\sigma_{140}$, was estimated to be ¼. 11 references. (auth)

3540 Measurement of the Half-Life and Mean Energy of T-itium Decay. G. H. Jenks, F. H. Sweeten, and J. A. Ghormley. ORNL-333, Mar. 28, 1950. 30p. (See also NSA 2-1692.)

An accurate determination of both the half-life and the average energy of tritium β decay has been made. The half-life was determined by measuring the rate at which the decay product He^3 was formed from a measured quantity of tritium. The average energy was determined by calorimetric measurement of the power generated by the same sample. A value of 12.46 ± 0.09 yr was found for the half-life, and a value of 5.69 ± 0.04 kev was found for the average energy of the decay of tritium to neutral He^3. 11 references. (auth)

PHYSICS

3541 High Energy Photons from Proton-Nucleon Collisions. B. J. Moyer, W. E. Crandall, R. Hildebrand, and H. York. UCRL-614, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

A recent article (Bjorklund et al, Phys. Rev. 77, 213-18 (1950)Jan. 15) summarizes the data up to September 1949 on these photons, discussing conceivable origins including the possibility of neutral meson creation and decay.

This paper deals with further data on yield and spectrum vs. proton energy, and yields vs. Z of target nucleus, showing comparisons with yields of charged π mesons.

The yield from collisions of 350-Mev protons with hydrogen nuclei has been measured by C-CH_2 difference methods to be less than 2% of the yield from collisions with carbon nuclei, in marked contrast with the relative yields for π mesons.

A "shadow casting" experiment to define the extent of the photon-emitting region has indicated the mean life of any intermediate particle, whose decay might yield the photons, to be less than 2×10^{-13} sec.

Improved data on angular distribution of the photons in the laboratory system, and transformed into the emitting system ($\beta \simeq 0.32$), will be presented.

Cloud chamber experiments are in progress to determine whether the photons are emitted singly or in pairs as would be expected from a neutral meson origin.

3542 New Radioactive Isotopes of Iridium. T. C. Chu. UCRL-624, Mar. 3, 1950. 32p.

Four new isotopes of iridium have been prepared by bombarding isotope-enriched rhenium as well as natural rhenium with α particles, and osmium with deuterons. Three of them have been identified as follows:

Isotope	Half-life	Type of Radiation	Energy of Radiation(Mev) Particle	γ rays	Produced by
Ir^{187}	11.8 hr	K$\beta^+e^-\gamma$	β^+ 2.2 e^- 0.28, 1.2	L, K x-rays 1.3	Re(α,2n) Re^{185}(α,2n) Os(d,3n)
Ir^{188}	41.5 hr	K$\beta^+e^-\gamma$	β^+ 2.0 e^- 0.16, 0.85	L, K x-rays 1.8	Re(α,n)(α,3n) Re^{187}(α,3n) Os(d,2n),(d,3n)
Ir^{190}	3.2 hr	K(?)$\beta^+e^-\gamma$	β^+ 1.7 e^- 0.2, 0.8	--	Re(α,n) Re^{187}(α,n) Os(d,n),(d,2n)

The 3.2 hr period is an isomer of the 12.6-day Ir^{190}. Another weak activity, possibly Ir^{189}, of more than 100 days half-life has been observed. Four daughter activities of iridium (9.5-min, 6-hr, 35-hr and around 50-day radioosmium) have been found, and their possible genetic relations discussed. A rhenium activity of around 1 hr halflife has been noticed in the Os + 19-Mev deuteron experiment. (auth)

3543 Radioactive Isotopes of Tantalum and Wolfram II. Geoffrey Wilkinson. UCRL-625, Mar. 16, 1950. 6p.

The radiation characteristics of a 21.0-day tungsten activity produced in the bombardment of tantalum with protons and deuterons from the 184-inch cyclotron have been studied together with the characteristics of the 9.3-minute tantalum daughter of the tungsten activity.

PHYSICS

Isotope	Decay	Half-life	Energy of Radiations Particles	x-rays	Produced by
$Ta^{179,8}$	K,β^+,e^-,γ	9.35 ± 0.05 min	0.08 e^- 1.06 β^+	L,K x-rays ~1.5	W^{179} 21.0 day K decay Hf - d - n, 2n
$W^{179,8}$	K, γ	21.0-0.2 days		L,K x-rays ~0.27 (weak)	Ta-p-3n Ta-d-4n

3544 The Angular Distribution of Annihilation γ Quanta. N. A. Vlasov and B. S. Dzhelepov. Doklady Akad. Nauk. S.S.S.R. 70, 207-10(1950) (in Russian).

The angular distribution of annihilation quanta was measured with the aid of (1) a source consisting of radioactive Cu wrapped in an Al foil, and (2) two groups of Bi counter groups placed on both sides of the source and recording coincidences at the passage of pairs of annihilation quanta; the number of coincidences varied with the angle θ between the directions of the two quanta. The curve obtained shows a sharp symmetric maximum at $\theta = 180$ deg, with more than one half of all cases falling within the interval ± 179.7 deg, a fact that testifies to the predominantly small energies (<10 ev) of the annihilating positrons. This result is confronted with some consequences of Dirac's annihilation theory (Proc. Cambridge Phil. Soc. 26, 361(1930)). This latter gives the angular distribution $I(\theta,\gamma)$ of quanta produced by the annihilation of monochromatic positrons (of energy γ) with electrons of zero kinetic energy: The probability of an annihilation increases with the angle ± $(180-\theta)$ deg and reaches a limit at a certain value of that angle, which is characteristic for a given γ. However, a direct application of these rules to the problem in view is impossible, since the energy spectrum of low-energy (less than 10 ev) positrons is unknown. An indirect approach can be attempted by reversing the conditions and considering the annihilation of positrons of zero kinetic energy with metal electrons having Fermi's energy distribution $f(\epsilon)$. Then the angular distribution of the quanta is $I_1(\theta) = \int_0^{\epsilon_0} I(\theta,\epsilon)\, f(\epsilon)\, d\epsilon$. For $\epsilon_0 = 10$ ev a curve is obtained which is shaped as a broad flat-topped maximum and is thus quite unlike the authors' experimental curve. This significant discrepancy between the consequences of Dirac's theory and the experiment shows that the annihilation of pairs of a low total momentum has a considerably higher probability than that implied by the theory.

3545 Determination of the Maximum Energy of the β Rays from 16-Hour Am^{242}. Jean M. Grunlund, B. G. Harvey N. Moss, and L. Yaffe. Phys. Rev. 78, 69-70(1950) Apr. 1 (Letter to the editor).

A sample of Am^{241} was irradiated in the NRX pile. The active material was dissolved off the foil using 8M HNO_3 and the solution was diluted to a standard volume. An aliquot of the sample was placed on a thin Formvar film and evaporated so that essentially a weightless point source was formed. Its activity was then measured using a Geiger-Mueller counter with an end window. An absorption curve of the radiation from the irradiated sample of Am^{241} was taken. The technique employed was similar to that used by Yaffe and Justus (Can. J. Research B26, 734(1948)) to determine the maximum energy of S^{35}. This curve is reproduced, and is found to have two components, one corresponding to a 16-hr Am^{242} β activity produced by the neutron irradiation. The other component is probably due to

PHYSICS

x-radiation from Am^{241}. The authors propose a value of 0.63 ± 0.01 Mev as the maximum energy of the betas emitted by Am^{242}. This differs from previously published results.

3546 Energies of Some Gamma-Rays from ThC", RaC, Na^{24}. J. L. Wolfson. Phys. Rev. 78, 176-8(1950) Apr. 15 (Letter to the editor).

A series of precise measurements were made of the energies of the γ rays of nominal values 2.62 Mev from ThC", and 2.2 Mev and 2.4 Mev from RaC. In addition some measurements of the Na^{24} γ ray at nominal value 2.76 Mev are given. The measurements were based upon comparisons of the γ rays with either the 0.4112 ± 0.0001 Mev transition following Au^{198} decay or the 1.3316 ± 0.0010 Mev γ ray from Co^{60}, utilizing internal or external conversion. An iron-free single lens β-ray spectrometer of focal length 9 cm was used, adjusted for line widths at half-maximum intensity ranging from 1.6 to 1.9% in momentum.

3547 The Fission Yield of Xe^{133} and Fine Structure in the Mass Yield Curve. J. Macnamara, C. B. Collins, and H. G. Thode. Phys. Rev. 78, 129-34(1950) Apr. 15.

A mass spectrometer investigation of the xenon isotopes formed from U^{235} fission has been made and the fission yield and half-life of Xe^{133} have been determined. The fission gases were extracted, purified, and the mass spectrometer abundance data were obtained within two weeks of the end of the irradiation period. The fission yield of Xe^{133} was found to be 6.29 ± 0.01% which is 20% higher than that expected from the mass yield curve. This is further evidence of fine structure in the mass fission yield curve. The half-life value of Xe^{133} was found to be 5.270 ± 0.002 days. (auth)

3548 New Beta-Emitting Isotopes in Region of Tungsten. M. Lindner and J. S. Coleman. Phys. Rev. 78, 67(1950) Apr. 1 (Letter to the editor).

Samples of tungsten, rhenium, and osmium which had received considerable neutron exposures in a nuclear reactor were examined for products of consecutive neutron-capture by the heaviest stable isotope of each element. A long-lived activity was found in the rhenium after decay of 50-day Re^{184}. Further work is being done to ascertain whether this is due to impurity, to a nuclide attributable to mass 189, or to the recently described (Wilkinson and Hicks, Phys. Rev. 77, 314(1950)) Re^{183} of 240-day half-life. Neither W^{188} nor Os^{194} could be observed directly because of masking by comparatively large amounts of long-lived known isotopes of these elements formed by first-order neutron capture, but the presence of Re^{188} and Ir^{194} daughters in tungsten and osmium, respectively, demonstrate conclusively the presence of the two parent activities. All half-lives appear to be of the order of months, but further work is being done to determine these values accurately, and the data will be reported at a later date.

3549 On the Disintegration Scheme of I^{131}. I. Feister and L. F. Curtiss. Phys. Rev. 78, 179-80(1950) Apr. 15 (Letter to the editor).

An I^{131} source was deposited on a 1.7 mg/cm² Al backing in the form of AgI with an average surface density of 0.5

PHYSICS

mg/cm². The window of the counter employed had a thickness of 1.0 mg/cm². The principal component of the β spectrum was found to have an end point at 606 ± 5 kev, the soft component at 306 ± 15 kev. A Fermi plot of the β spectrum is given. The authors conclude that their results are in agreement with the findings and proposed decay scheme of Metzger and Deutsch (Phys. Rev. 74, 1640 (1948)).

3550 On the $\gamma-\gamma$-Angular Correlation in Pd^{106}. J. A. Spiers. Phys. Rev. 78, 75-6(1950) Apr. 1 (Letter to editor).

The author gives an expression for the angular correlation between the two successive gammas emitted by Pd^{106}. It has been shown that the form of this expresssion eliminates certain possibilities as to the multipole order of the two γ rays (Ling and Falkoff, Phys. Rev. 76, 431(1949); 76, 1639(1949)). The author has calculated the correlation to be expected on the assumption that γ_2 is pure octupole ($J_2 = 3$) and γ_1 pure octupole ($J_1 = 0$), pure quadrupole ($J_1 = 1$) and mixed dipole-quadrupole ($J_1 = 2,3$). The correlation obtained on the basis of this assumption is not of the correct form. Higher values of J_1 were tried with the same results. A correlation of the correct form can, however, be obtained if it is assumed that one of the excited levels of Pd^{106} consists in fact of two levels with different spins, but with approximately the same energy. A level scheme for Pd^{106}, consistent with the form of the correlation function, is proposed.

3551 A Precise Determination of the Energy of the Cs^{137} Gamma-Radiation. Lawrence M. Langer and R. Douglas Moffat. Phys. Rev. 78, 74-5(1950) Apr. 1 (Letter to the editor).

The energy of the γ radiation and conversion electrons from Cs^{137} has been determined with great precision, so that the conversion electrons may be used for the calibration of nuclear spectrometers. The energy of the conversion electrons was determined by direct comparison with that of the γ ray of Au^{198}. The measurements were made with the 40-cm radius of curvature, 180-deg focusing, shaped magnetic field spectrometer (Rev. Sci. Instruments 19, 257(1948)). A composite source of Au^{198} and Cs^{137} was prepared on a 0.00025-in. Al backing. The source was 0.25 cm wide and 2.5 cm high and was spread with the aid of insulin. The source thickness was estimated to be 0.03 mg/cm² of Au^{198} and 0.1 mg/cm² of Cs^{137}. The energy of the γ ray, as calculated from the conversion electron energy, was found to be 0.6614 ± 0.0007 Mev.

3552 Published Information on the Decay of Fission Products. Atomic Energy Research Establishment Report No. AERE-Inf/Bib-63, Mar. 20, 1950. 22p.

This bibliography is divided into two parts. The first contains 80 references to American declassified reports. The second, containing 137 references, has been compiled from Chemical Abstracts, Science Abstracts A, and Nuclear Science Abstracts. (auth)

3553 A Reinterpretation of the Electron Spectra of Radioactive Ytterbium and Tantalum. J. M. Cork, H. B. Keller, W. C. Rutledge, and A. E. Stoddard. Phys. Rev. 78, 95-8(1950) Apr. 15.

PHYSICS

Highly purified ytterbium, on irradiation in the pile, yields radioactivities whose half-lives are found to be 32.4 days, 4.2 days, and 6.7 days, in addition to the 2.4-hr activity known to exist. The 32.4-day activity is assigned to Yb^{169} which decays by K-capture to excited Tm^{169}, yielding no general β radiation, but about 30 electron conversion lines which are interpreted as due to 10 γ rays fit into a simple level scheme. The 4.2-day activity is assigned to Yb^{175} and in addition to a strong β radiation shows conversion electron lines indicative of 4 γ rays. It is shown that the 6.7 day activity is a daughter product in Lu^{177}, growing from a radioactive Yb^{177} which is presumably the well-known 2.4-hr activity. A re-interpretation of the approximately 40 electron conversion lines in radioactive Ta^{182} leads to 18 γ rays, all of which fit well a proposed energy level scheme. (auth)

3554 On the Use of the Tomonaga Intermediate Coupling Method in Meson Theory. Kenneth M. Watson and Edward W. Hart. UCRL-642, Mar. 30, 1950. 33p.

It is shown that the Tomonaga method (Prog. Theor. Phys. 2, 6(1947)) for obtaining an intermediate coupling approximation in meson theory can be formulated very simply and will in general give accurate results in the limits of weak and strong coupling. The problem of nuclear forces in the charged scalar theory is studied. The ratio of ordinary to exchange forces is given as a function of the coupling strength. Photomeson production is studied in the intermediate coupling region for both charged scalar and charged pseudoscalar theories. The method is seriously limited, in that nucleon recoil is neglected. (auth)

3555 Analysis of Proton-Proton Scattering by Means of the f Function. G. Breit and R. D. Hatcher. Phys. Rev. 78, 110-14(1950) Apr. 15.

The approximately linear relationship between the f function and the energy, E, is discussed by elementary methods. Formulas for the comparison of derivatives of f with respect to E are given for potentials of different shapes. The comparison of potentials is reduced to that of wave functions at a standard energy. A discussion of the relation between the meson mass corresponding to experiments on proton-proton scattering and the mass of the π meson is included. The variation in the comparison owing to lack of reproduction of the curvature of the (f,E) plot is estimated and the uncertainties caused by the relativistic corrections as well as modifications of the Yukawa potential at distances of the order of the Compton wave-length for the proton are considered. (auth)

3556 Commutator Equations for Fields Derived from a Variation Principle. Christopher Gregory. Phys. Rev. 78, 67-8(1950) Apr. 1 (Letter to the editor).

The author shows that the "quantal" equations for the electromagnetic field in a vacuum may be derived from the following variational equation: $G = -\frac{1}{4}(F^{\mu\nu})mn(F_{\mu\nu})nm$; $\delta G = 0$; where $(F^{\mu\nu})mn$ is the matrix element of $F^{\mu\nu}$ and $F^{\mu\nu} = i[p_\mu, A_\mu] - i[p_\nu, A_\mu]$. From these equations the author derives the commutation relations for p and F (the "quantal" equations of the field).

3557 The Effect of Exchange Forces on the Electromagnetic Radiation. I. Pomeranchuk and I. Shmush-

kevich. Doklady Akad. Nauk S.S.S.R. 70, 33-6 (1950) (in Russian).

In Doklady Akad. Nauk S.S.S.R. 64, 499(1949), the authors have shown that charge exchanges occurring during neutron-proton collisions cause a considerable increase in the intensity of the photon radiation, and a formula has been given representing the cross section of the process as a function of the cross section of an elastic neutron-proton collision; this formula has then been used for the evaluation of the cross section of the scattering of fast neutrons by nuclei of various elements as a function of the cross section of the corresponding elastic scattering. In the present paper the remark is made that such a use of the above formula may not be legitimate, because an impinging particle (neutron or proton), upon entering a heavy nucleus, may undergo not one but several collisions with the nucleons, before leaving the nucleus. An analysis of the situation shows that within a degree of magnitude the formula in question is valid for collisions of fast (or protons) with nuclei. The effect studied here should probably be taken into consideration when interpreting cases of intensive photon radiation such as that observed by Mayer et al (Bull. Am. Phys. Soc. 24, No.2, 19; No.4, 36(1949)), where fast protons, obtained in the cyclotron, collided with nuclei. An evaluation is also made of the energy loss sustained by a fast particle during a collision of the kind studied here; it is found that this loss grows with the particle's energy, and that it may become notable for ultra-relativistic velocities. A characteristic property of the radiation in question is its polarization, which is different for variously directed rays.

3558 Further Remarks on Albert Einstein's Special Relativity. Quirino Majorana. Atti accad. naz. Lincei. Classe sci. fis. mat. e nat. 7, 32-7(1949) (in Italian).

In a previous note (Atti. accad. naz. Lincei. Classe sci. fis. e nat. 5, 211) the author has pointed out some of the difficulties encountered by the special relativity theory when applied to concrete cases. The present paper offers several further remarks on the same subject. A study is made of the known hypothetical case of two observers A and A′ moving upon the same rectilinear path, but with different relative velocities, toward a point B from which a light signal is emitted. The Lorentz transformation informs that the two observers will locate this event at different points of space and in different moments of time; this applies also to the special case when A and A′ happen to be in the same point of the path when the signal reaches them. The latter conclusion is regarded by the author as physically impossible. Since the signal may be supposed to be an instantaneous illumination of the face of a clock located at B and marking the time of the emmission, both A and A′, receiving the signal when occupying the same point of space, will see the same image and will reach the intuitively true conclusion that the time elapsed since the illumination of the clock is a uniquely determined interval, true for all observers, whatever their relative velocities. The source of the contradiction is, of course, the postulate of the constancy of light velocity, which forms the basis of the relativity theory. The author refuses to accept this assumption until more experimental proof is assembled. He mentions that he has begun tests of this kind.

3559 Interaction of Electrons and an Electromagnetic Field Treated by Analytic Continuation. S. Bertil Nilsson. Arkiv for Fysik 1, 369-423(1949) Nr. 19

The analytic-continuation method ("α method") for eleminating divergences has been found to be equivalent with the λ-limiting process in the classical theory of point charges, but to be more powerful in the quantum theory. This paper contains an alaboration of the two forms in which the α method has been introduced into quantum electrodynamics (by Gustafson and by Pauli) and further discusses their interrelation and the connection with the classical theory of Riesz and Fremberg and with the λ process. The logarithmic divergences, which have so far been unaffected by the method, are now removed in the simplest cases (though not in the higher approximations); if the procedure is combined with Schwinger's method, the infinite mass-term that Schwinger isolates then becomes finite. (auth)

3560 The Mass Defect as a Consequence of the Relativistic Equation of the Two-Body Problem. Walter Thirring. Z. Naturforsch. 5a, 85-8(1950) Feb. (in German).

A relativistic field equation for two particles with spin ½ is formulated, which leads to a Schroedinger equation for the center-of-mass coordinates in which the mass is the sum of the masses of the two particles minus the binding energy. The treatment of the problem is in many respects the quantum-mechanical analog of a classical treatment by Bagge (Z. Naturforsch. 1, 361(1946)).

3561 Minimum and Maximum Limits of Photon-Energy. G. J. Whitrow. Nature 165, 281(1950) Feb. 18 (Letter to the editor).

According to a recent suggestion by Milne (Kinematic Relativity, chap. 8, Oxford, 1948) Planck's constant h varies linearly with the time, t, the variation being significant for the interpretation of the spectra of distant galaxies. The present value of t is assumed to be of the order of 2×10^9 years. The author points out that Milne's assumption implies that $h/t \sim 10^{-43}$ ergs will be a fundamental constant and secular invariant. Moreover, $h/c^2t \sim 10^{-64}$ g $\sim m/\sqrt{N}$, where c is the velocity of light, m the mass of the proton, and N Eddington's number 10^{79} (indicating the order of magnitude of the equivalent number of protons in a universe of mass 10^{55} g). Substituting $r\sqrt{N}$ for ct, the fundamental unit of length $h/mc \sim 10^{-13}$ cm is obtained. The energy of a photon can be written $E = hc/\lambda$. It is suggested that the wavelength λ can vary from ct to r, which yields as a minimum the unit of energy h/t found above and as a maximum the energy hc/r which is comparable to mc^2, the inertial energy of the proton.

3562 Non-Local Fields. M. Fierz. Phys. Rev. 78, 184 (1950) Apr. 15 (Letter to the editor).

It is pointed out that certain equations in Yukawa's theory of nonlocal fields (Phys. Rev. 77, 219(1950), Eqs. 3 and 14) are equivalent to expressions occurring in an earlier theory of Fierz (Helv. Phys. Acta 12, 3(1939), Eqs. 1.1 and 1.3). It is concluded that the two theories are equivalent. These considerations refer to the force-free case. It is conceded, however, that it may be possible to introduce interactions in such a way that the equivalence of the two theories will be lost.

3563 On the Charge Independence of Nuclear Forces. Julian Schwinger. Phys. Rev. 78, 135-9(1950) Apr.

It is shown that the small difference between the neutron-proton and proton-proton interactions in the ^1S state can be

PHYSICS

accounted for by magnetic forces, provided the nuclear interaction is described by the Yukawa potential. A variational principle is used to facilitate the comparison of the interactions, and for the determination of the effect of magnetic forces. A short discussion of variational principles is presented in the Appendix. (auth)

3564 On the Role of the Subsidiary Condition in Quantum Electrodynamics. F. Coester and J. M. Jauch. Phys. Rev. 78, 149-56(1950) Apr. 15.

The S-matrix in quantum electrodynamics may be calculated alternatively from the Hamiltonian density $-j^{\mu}(x)A_{\mu}(x)$ and a Hamiltonian in which the coulomb interaction of the charges and the interaction of the currents with the transverse field are separated. Both procedures are equivalent. Care must be taken, however, to define correctly the initial states, in particular the vacuum state. The definition of the vacuum state in both representations is discussed and the equivalence of the corresponding S-matrices is proved. (auth)

3565 Practical Calculation of Magnetizing Force. A. A. Halacsy. Proc. Inst. Elec. Eng. 97, Part I, 37-42 (1950) Mar.

PHYSICS

Any vector component of the magnetic field strength at a point in space due to an electric current is directly related to a vector representing the surface swept over by the radius vector of length $1/\sqrt{r}$ with its origin and direction the same as those of the radius vector r directed from the point in question to consecutive points on the path of the influencing current. This relationship enables magnetic field strength, distribution of the magnetic field, electromagnetic forces, etc., to be calculated by means of simple geometry in all practical cases, including those in which no simple analysis has so far been possible.

3566 The Relativistic Mass-Energy Relationship--Has It Been Verified Accurately? S. W. Flügge. Nucleonics 6, 67-74, (1950) Apr.

The author discusses the quantitative verification of the Einstein mass-energy relation $E = Mc^2$. Seven mass-spectroscopic results of Mattauch lead to complete confirmation with a probable error of less than 0.5%. Determinations based on β decay, while theoretically possible, cannot yet be made with sufficient accuracy. The author reaches the conclusion that more exact verifications of the mass-energy relation would be desirable, but that no strong contradiction to the theoretical value is known.

AUTHOR INDEX

For each reference the digit preceding the dash is the volume number and digits after the dash are the abstract number.

ABRAHAM B M
4-3409
ADLER T K
4-3370
ALLER L H
4-3460
ALTSHULER S A
4-3535
ALVARO M E
4-3341
ANDERSON V E
4-3406
ANKER H S
4-3394
ARIEL I M
4-3308
ARTOM C
4-3357
ASTON M J
4-3290

BARBER A
4-3304
BARR J T JR
4-3407
BASSETT L G
4-3450
BASTIN E
4-3472
BECKER J
4-3472
BECKS H
4-3273
BEENAKKER J J M
4-3458
BEIERWALTES W H
4-3391
BELANGER L F
4-3382
BELL M E
4-3506
BELOGORSKY J B
4-3345
BENDICH A
4-3372 4-3376
BENE G J
4-3511
BERGER M
4-3322
BERKSON J
4-3395
BETHARD W F
4-3282
BETHE H A
4-3532
BIEHL A T
4-3469
BIGGS M W
4-3414
BLOCH K
4-3394 4-3396 4-3399
BLOCKER W
4-3518
BODANSKY O
4-3376
BODIAN D
4-3386
BOHLIN N G
4-3408 4-3409
BOISSONNAS R A
4-3384
BONILLA C F
4-3429
BORELL U
4-3371
BOULLE A
4-3426
BOYARSKY L L
4-3344
BRANNIGAN F L
4-3424
BREFFEILH L A
4-3304
BREIT G
4-3555
BREWER L
4-3419 4-3454
BRIGHTSEN R A
4-3509
BROSER I
4-3496 4-3534
BROWN G B
4-3372 4-3376
BROWN L O
4-3404
BROWNELL G M
4-3498
BROWNING E
4-3292
BRUECKNER K A
4-3466
BRUNST V V
4-3280 4-3283
BUESSELER J A
4-3318
BUETTNER K
4-3294
BURCHAM W E
4-3524
BURKHART L E
4-3418
BURSTONE M S
4-3278

CALKINS L L
4-3318
CALVET F
4-3398
CALVIN M
4-3361
CAMPBELL A D
4-3334
CANADA A H
4-3418
CARPENTER C P
4-3346
CARTWRIGHT W F
4-3465
CARVALHO N
4-3330
CASSEN B
4-3270
CAYER D
4-3557
CHAIKOFF I L
4-3377
CHAMBERLAIN R H
4-3329 4-3379
CHANSON P
4-3472
CHAPMAN C L
4-3333
CHARNY C W
4-3321
CHENHALL F N
4-3333
CHERNICK S S
4-3377
CHEW G F
4-3501
CHISHOLM E O
4-3439
CHOLAK J
4-3359
CHU T C
4-3542
CHUPAK J
4-3453
CLARKE A M
4-3529
CLARKSON P
4-3288 4-3289
COESTER F
4-3564
COHN W E
4-3413
COLE W H
4-3309
COLEMAN J S
4-3548
COLEMAN R D
4-3273
COLLINS C B
4-3547
COOK W A
4-3297
COOPER B J
4-3374
COPP D H
4-3273 4-3342
CORINALDESI E
4-3537
CORK B
4-3532
CORK J M
4-3553
CORNATZER W E
4-3357
COUTARD H
4-3324
CRAIGHEAD C M
4-3447
CRANDALL L A JR
4-3362
CRANDALL W E
4-3541
CSERVENYAK F J
4-3446
CURTISS L F
4-3549

DAANE A H
4-3422
DANIEL G
4-3326 4-3338
DANTOINE G
4-3330
DARGENT M
4-3322
DAUBEN C H
4-3419
DAVIS W JR
4-3405
DAWSON R M C
4-3375
DECKER A B
4-3272
DECOURSEY E
4-3293
DEIGHTON M O
4-3493
DE LA GARZA A
4-3482
DENIS P M
4-3511
DENNIS R H
4-3316
DIEHL W K
4-3339
DIEKE G H
4-3499
DISMUKE N
4-3516
DOKOUPIL Z
4-3458
DOMINO-BERGES M
4-3426
DOROUGH G D
4-3361
DRINKER P
4-3297
DUCOFF H S
4-3364
DUHAMEL J
4-3315
DUTRA F R
4-3359
DU VIGNEAUD V
4-3384
DZHELEPOV B S
4-3544
DZIEWIATOWSKI D
4-3386

EASTWOOD L W
4-3443 4-3447
EDGE N D
4-3357
EDMONDS B G
4-3381
EISENBERG S J
4-3323
EISENBUD M
4-3424
ELLIOT J O
4-3497
ENGEL D G
4-3457